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Ghanaian JSS2 Students' Abysmal Mathematics Achievement in Timss-2003: A Consequence of the Basic School Mathematics Curriculum

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[Paper presented at the ***West African Examinations Council (WAEC) Monthly Seminar****,* at WAEC Conference Hall, Accra, May 27, 2005[

Abstract

In 2003, Ghana for the first time participated in TIMSS in order to find out how the performance of her eighth graders (JSS2) in science and mathematics compared with those of other countries. This paper presents an overview of the performance of the JSS2 students in the TIMSS-2003 in mathematics, with particular reference to the released items. The analysis of the Ghanaian students' performance on the released items indicated that Measurement, Geometry and Algebra were the candidates' weak content areas. The mean percentage of Ghanaian students making correct responses to the released items in Algebra, Measurement and Geometry were 13.6, 17.3 and 13.4 percent, respectively. For Number and Data, the mean percentage making correct responses to the released items were 22.6 percent and 27 percent. The Ghanaian students found the constructed response items more difficult than the multiple-choice items. The mean percentage of students who were able to provide the correct responses to the multiple-choice items was 21.6 percent while that observed for the constructed response items was 12.1 percent. The paper also presents the results of analyses of Ghanaian mathematics curriculum (textbooks and what teachers taught); and also the BECE-2004 and TIMSS-2003 test items. It was observed that the Ghanaian curriculum places a great deal of emphasis on number and in addition, most (77%) of the items in the BECE elicited responses in the lowest cognitive domain, i.e. 'knowledge of facts and procedures'. The BECE included only few (12.1%) items that required the students to solve routine problems. None of the BECE items can be classified as one that required some higher level reasoning from the students. The TIMSS on the other hand devoted 36 and 21.6 percent of its items to solving routine problems and reasoning, respectively. It can be argued in this light that the Ghanaian mathematics curriculum does not meet requirements that are currently valued globally in school mathematics. The poor performance is therefore largely a reflection of the nature of school Mathematics curriculum and assessment system that students have experienced in this country in the last three decades. No wonder only 42 percent of Ghanaian JSS mathematics teachers used the mathematics textbooks as the main basis for mathematics lessons. The writers believe that not until Ghana abandons the "*new maths*" schemes which had remained in the nation's schools since 1975 and adopts textbook schemes that offer what is currently valued globally in school mathematics, Ghanaian students' performance in the subject will continue to be abysmally low.

Introduction

Trends in International Mathematics and Science Studies (TIMSS) 2003 is the third in a series of studies undertaken once every four years by the International Association for the Evaluation of Educational Achievement (IEA) to examine student achievement in science and mathematics, two key curriculum areas that are fundamental to the development of technologically literate societies. TIMSS-2003 seeks to continue to monitor trends in science and mathematics at the eighth grade (JSS2) and at the fourth grade (Primary 4). Ghana's participation in TIMSS-2003 was strategic as it enabled the country to find out how the performance of her eighth graders (JSS2) in science and mathematics compared with those of other countries (Mullis, et al., 2004; Martin, et al., 2004).

In Ghana, TIMSS-2003 involved a total of 5,114 JSS2 students in 150 schools sampled across the country. The mathematics in the official curriculum materials (i.e. the 1987 syllabi and Ghana Mathematics Series textbooks) used by this cohort of JSS students from primary to junior secondary school were the type that were described as 'modern mathematics' in Europe and 'new math' on the other side of the Atlantic (Howson, Keitel, and Kilpatrick, 1981). Though in the 1980s concerns were raised internationally for countries still using the 'new math' textbook schemes to adjust them (Howson and Wilson, 1986), Ghana has been very slow in responding to this concern. While the 1987 syllabi were reviewed and supplied to schools in 2001, two years before the TIMSS study, no matching textbooks have been supplied to schools. This implies that the nature of mathematics experienced by this cohort of JSS2 students hardly meets requirements that are currently valued globally in school mathematics.

This paper presents an overview of the performance of the JSS2 students' achievement on TIMSS-2003 released items in mathematics and examines the relationship between the performance and the *new math* schemes that have remained in the nation's schools for three decades.

TIMSS assessment framework for mathematics

The mathematics assessment framework for TIMSS-2003 was covered by two organising dimensions, a content dimension and a cognitive dimension. There were five content domains: Number, Algebra, Measurement, Geometry and Data. Items in these content domains were designed to elicit the use of particular cognitive skills in four cognitive domains, namely, Knowing Facts and Procedures; Using Concepts; Solving Routine Problems; and Reasoning. The Mathematics Cognitive Domains involved the use of such processes as

- *Knowing facts and procedures*: recall; recognize; compute; use tools.
- *Using concepts*: know; classify; represent; formulate; distinguish.
- *Solving routine problems*: select; model; interpret; apply; verify/check.
- *Reasoning*: hypothesize/predict; analyze; evaluate; generalize; connect; synthesize; solve non-routine problems; justify/prove (Mullis, et al., 2004).

Below are the main topics that the items covered in the five content domains:

a. *Number (i.e. fractions and number sense)* – includes whole numbers and integers; common and decimal fractions including their meaning and representation, operations, relations and properties, estimation; and proportionality.

b. *Measurement* – includes concepts of measurement, units of measurement, perimeter, area, and volume, and estimation of measurements.

c. *Data (i.e. representation and interpretation of data, and probability)* – includes interpretation of tables, charts, and graphs, and simple descriptive statistics such as means; simple probability concepts and numerical probability.

d. *Geometry* – includes congruence and similarity; transformations and symmetry; coordinate geometry; points, lines, angles, parallels and perpendiculars; polygons (including triangles and quadrilaterals); and circles.

e. *Algebra* – includes linear equations; algebraic expressions and formulas, linear inequalities, simple linear system, and number patterns; setting up and solving simple proportionality *equations* (Mullis, et al., 2004).

Overview of overall achievement in mathematics

Out of the 46 countries that participated, Ghana was second from the bottom of the results table with a mean score far below the international average. The mean mathematics score of 276 and its range (as indicated by the difference between the 5th and 95th percentiles) for JSS2 students are presented in Table 1.

Table 1 JSS2 Students' mean mathematics score in TIMSS-2003

JSS2 students	Mean mathematics scale score
Overall mean	276 (4.7)*
Range (95% confidence interval)	130 - 430

*Standard error in parentheses
[Source: Anamuah-Mensah, Mereku and Asabere-Ameyaw (2004)].

The mean score was significantly low compared to the international mean score of 467. It placed Ghana at the 45th position out of the 46 countries participating in the study. The range of scores from 130 to 430 shows how diverse the JSS2 students were in their mathematics abilities.

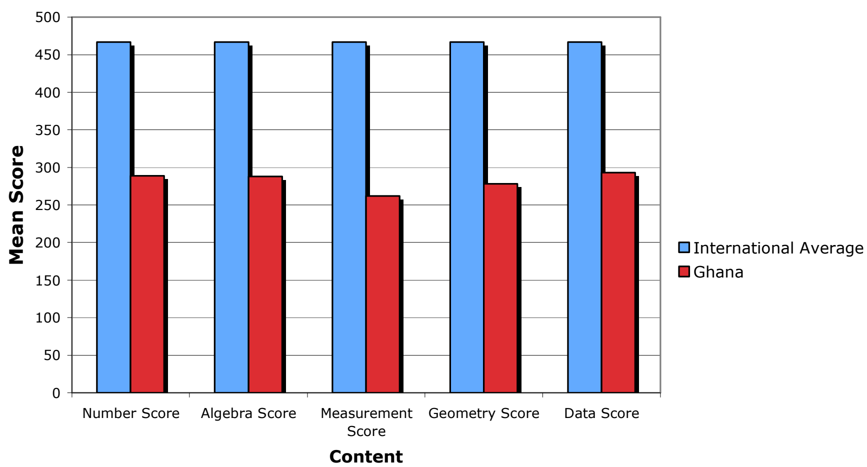
The mean percentage correct on all mathematics test items for each participating Ghanaian student was 15 and only 9% and 2% of the students reached the low and intermediate international benchmarks respectively. The performance of the JSS2 students in the TIMSS was unsurprisingly very poor because of the nature of mathematics students were made to experience at school in this country. Analyses of the students' performance on the TIMSS mathematics test items show that the few (about 15%) items for which most students were able to make correct responses were those that were testing knowledge of facts and procedures. They performed poorly on items that tested their ability to use concepts, solve non-routine problems and reason mathematically (Anamuah-Mensah, et al, 2004).

Mean achievement in mathematics content domains

The five content domains listed above constitute independent subgroups with a common reporting metric (or scale) that makes it possible to compare the relative strengths and weaknesses of the students in relation to their performance in the different content domains (or categories). The international mean was placed at 467 for each of the five reporting domains. The mean performance of the Ghanaian JSS2 student in all the five mathematics content areas was as follows: Number, 289; Algebra, 288; Measurement, 262; Geometry, 278, and Data, 293.

These mean scores were significantly lower than the international means in each of the content areas and were about 180 scale score points below the international means. It can also be seen from Figure 1 that there was little difference in the achievement of the Ghanaian students in the different mathematics content areas.

Figure 1 Relative strengths of Ghanaian JSS 2 students in the mathematics content areas tested in TIMSS-2003



Ghanaian students' achievement in the mathematics content domains was also compared to those of selected countries[1]. In doing this comparison, note was taken of the different curriculum emphases among the countries, as well as relationships between the test items used in TIMSS-2003 and the curriculum.

In Table 2 achievement in the five content areas for Ghana, five other African countries, England, United States of America, Japan, Chinese Taipei, Malaysia, Singapore and Korea are presented. Ghanaian students' performance was far below that of all selected countries except South Africa, in all content areas. It is noteworthy that in none of the mathematics content areas did students' achievement reach a level where it could be said that they have a relative strength in that area in comparison to other countries. It can be seen from the table that Ghana's average score in Measurement and Data were the lowest of all the participating countries. The average difference in performance between Ghanaian students and students in the highest performing country, Singapore, is about 310 scale points in all content areas. The African country with the highest mean score in mathematics, Tunisia (410), out-performed Ghana in the five content areas by an average of about 120 scale points. South Africa, whose overall performance was similar to that of Ghana, had a similar relative strength in the five areas to that of Ghana.

[1] The criteria for the selection was based on whether the country had a similar economic and educational status at the time of Ghana's independence, was African, or currently has a strong political and economic ties with Ghana.

Table 2 **Country mean scale scores for mathematics content areas by selected participating countries**

	Number Score	Algebra Score	Measurement Score	Geometry Score	Data Score
Countries comparable to Ghana at Independence					
Singapore	618 (3.5)*	590 (3.5)	611 (3.6)	580 (3.7)	579 (3.2)
Korea	586 (2.1)	597 (2.2)	577 (2.0)	598 (2.6)	569 (2.0)
Chinese Taipei	585 (4.6)	585 (4.9)	474 (4.4)	588 (5.1)	568 (3.3)
Japan	557 (2.3)	568 (2.0)	559 (2.0)	587 (2.1)	573 (1.0)
Malaysia	524 (4.0)	495 (3.9)	504 (4.9)	495 (4.8)	505 (3.2)
African Countries					
Ghana	**289 (5.1)**	**288 (4.8)**	**262 (3.7)**	**278 (4.3)**	**293 (4.1)**
Egypt	421 (3.0)	408 (3.9)	401 (3.3)	408 (3.6)	393 (3.2)
Tunisia	419 (2.3)	405 (2.4)	407 (2.2)	427 (2.0)	387 (2.2)
Morocco	384 (2.7)	405 (2.8)	376 (3.4)	415 (2.3)	374 (2.5)
Botswana	382 (2.3)	377 (2.7)	377 (2.0)	335 (3.9)	375 (2.7)
South Africa	274 (5.4)	275 (5.1)	298 (4.7)	247 (5.4)	296 (5.3)
Countries with strong links with Ghana					
United States	508 (3.4)	510 (3.1)	495 (3.2)	472 (3.1)	527 (3.2)
England	485 (5.0)	492 (4.5)	505 (4.3)	492 (4.5)	535 (4.1)
International Average	467 (0.5)	467 (0.5)	467 (0.5)	467 (0.5)	467 (0.5)

*Standard error in parentheses

Source: (Anamuah-Mensah, et al, 2004).)

Performance on released test items in mathematics

One of the test forms for TIMSS-2003 was released in 2004. The form came with results of students' correct responses to the items. In analysing the released items, the following were taken into consideration: the type of item – multiple-choice and constructed-response, the content domain and the cognitive domain.

Performance on multiple choice and constructed response items

It was observed that 70 percent of the questions in the released items were of the multiple-choice type and the remaining 30 percent were constructed-response items. This was close to the test weightings used in the TIMSS framework, namely, 66 percent multiple-choice and 34 percent constructed-response items. The mean percentage of Ghanaian JSS2 students obtaining correct responses to the released items was 16.9. This was close to the overall mean percentage response on all the 194 items on the mathematics test, which was 15 percent. The mean percentage of students who provided the correct responses to the multiple choice items in the released items was 21.6 percent. This figure was nearly double the percentage observed for the constructed response items, which was 12.1 percent suggesting that the students either found the constructed response items more difficult than the multiple choice items or many of the responses they made to the multiple choice items could have been guess work.

Performance on selected test items in the mathematics content domains

Table 3 shows the percentage of Ghanaian students making correct responses to the TIMSS-2003 released items in the five content categories. It will be observed that students making correct responses to items in the number category ranged between 0.2 and 47.2 percent with a mean of 26.6 percent.

Table 3 **Mean percentage of Ghanaians students obtaining correct responses to the released items**

Content domain	Range	Mean
Number	0.2 – 47.2	26.6
Algebra	0.6 – 29.0	13.6
Measurement	0.5 – 39.0	17.3
Geometry	0.1 – 26.0	13.4
Data	2.4 – 48.5	27.0

Even though about 50 percent of the items in the number category elicited responses from the lower cognitive domains – knowing facts and procedures, and using concepts – they were difficult for most Ghanaian children because the items were largely word problems which many of the students had difficulty in solving due to inadequate exposure to such problems and poor reading abilities. Similarly, the percentage of students giving correct responses to released items in the data category ranged between 2.4 percent and 48.5 percent with a mean of 27 percent, making it the content area that most of the JSS2 students were able to respond correctly. The percentage range of students making correct responses to the released items in Algebra, Measurement and Geometry can also be seen in table. It will be observed that these were the content areas that the students found more difficult in the test. There were several items in these content areas that less than 1 percent of the students were able to do correctly.

TIMSS Evaluation of Coverage of the Intended and Implemented Curricula

The teaching syllabus for mathematics recommends that students at JSS2 received 25 percent of the total instructional time. This percentage of the total instructional time allocated to mathematics at JSS2 is the highest compared to all the TIMSS participating countries.

In Ghana no provisions are made in the national curriculum for addressing the issue of students with different levels of ability. That is, there is no differentiation of the content of the mathematics curriculum to meet the learning needs of groups of students with different levels of abilities. In other words, all students are made to experience the same amount of content in mathematics. This is however not so in many parts of the world today. This is because some of the content found in the curricula at this level, in some educational systems, have been found not to be essential knowledge for ALL, but additional knowledge for students with high abilities who will continue to study the subject in their further education after this level.

In many countries, the national curriculum is not addressing the issue of students with different levels of ability. But the performance of students in countries that address this issue is high. Singapore, where the best results were reported in both subjects, practices even a more extreme form of the differentiation in which the different curricula are used for different groups of students according to their ability level (Mullis, et al., 2004).

In the intended mathematics curriculum, 96 percent of TIMSS topics were expected to be taught to every student. The proportions of TIMSS topics in the five domains of mathematics are presented in Table 4.

Table 4 **Percentage of TIMSS topics in Ghana's Intended and Taught Mathematics Curriculum in the five Content domains**

Content domain	TIMSS Mathematics topics in Intended Curriculum		TIMSS Mathematics topics actually taught by teachers	
	Ghanaian Students (%)	International Average (%)	Ghanaian Students (%)	International Average (%)
All Topics	96	70	60	72
Number	100	96	83	95
Algebra	100	63	59	66
Measurement	100	78	53	78
Geometry	100	67	51	69
Data	75	39	55	46

Form the table it can be argued that there was no agreement between inclusion of TIMSS topics in the intended curriculum and the coverage of the implemented mathematics curriculum. The students' responses indicate that a good number of topics intended in most content areas were not fully covered. This may be due to the fact that many of the topics in Measurement and Geometry were expected to be taught in the third term of Year 8 (JSS2) and the whole of Year 9 (JSS3). With the exception of Data, the coverage of the mathematics topics was lower than the international average. In this light, it is worthy to note that the countries with high achievement in mathematics in the study also had high coverage of the TIMSS mathematics topics in the classroom (Mullis, et al., 2004).

Comparison of content and cognitive domains emphasised in TIMSS-2003 and BECE-2004

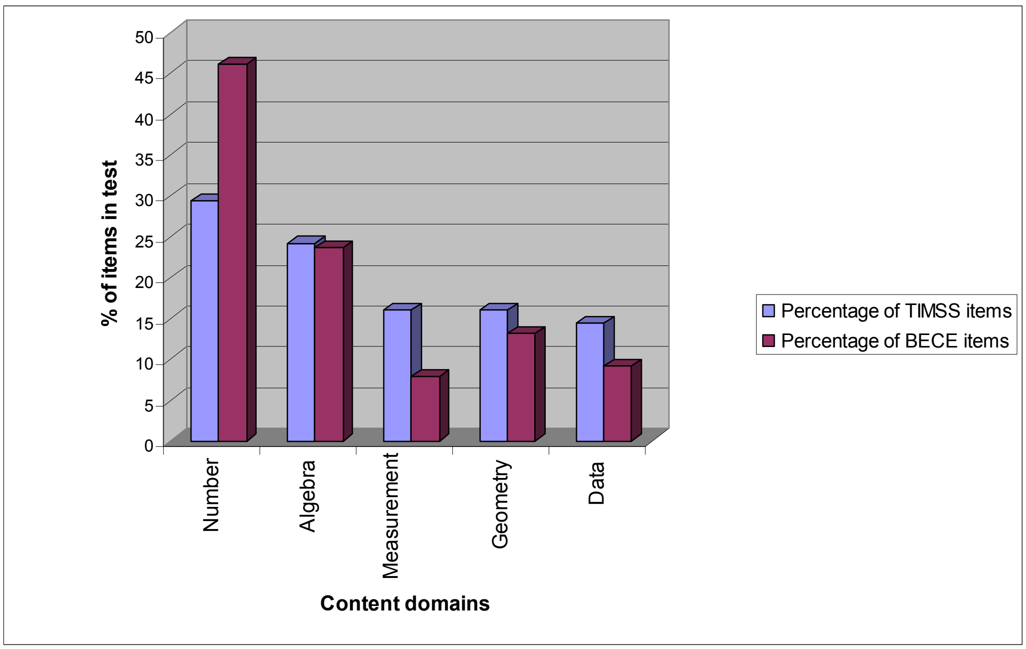
All students in basic education in Ghana write one public examination, Basic Education Certificate Examination (BECE), which is school leaving examination written at end of Year 9 (or JSS3). In this examination, students write papers in at least eight subjects including mathematics. BECE-2004 was taken by the same cohort of students who participated in the TIMSS-2003. While TIMSS-2003 reported that teachers claimed they taught 83 percent of the content under number, the final examination used to evaluate the basic programme, the BECE covered 46 percent of this content domain (see Table 5). That is, nearly half of the BECE items assessed this content area. In the TIMSS however, only 29.4 percent of the items came from this content domain.

Table 5 Emphasis on content domains in curriculum and assessment

Content domain	Percentage of TIMSS items	Percentage of BECE items
Number	29.4	46.1
Algebra	24.2	23.7
Measurement	16	7.9
Geometry	16	13.2
Data	14.4	9.2

There was also a great disparity between the TIMSS and BECE in their emphasis on measurement. Items in this content domain constituted 16 and 7.9 percent in the TIMSS and BECE respectively. Figure 2 shows that generally, besides number, the proportion of items in the other content areas in TIMSS was higher than those in the BECE.

Figure 2 Distribution of Items in TIMSS and BECE Mathematics by Content Domain



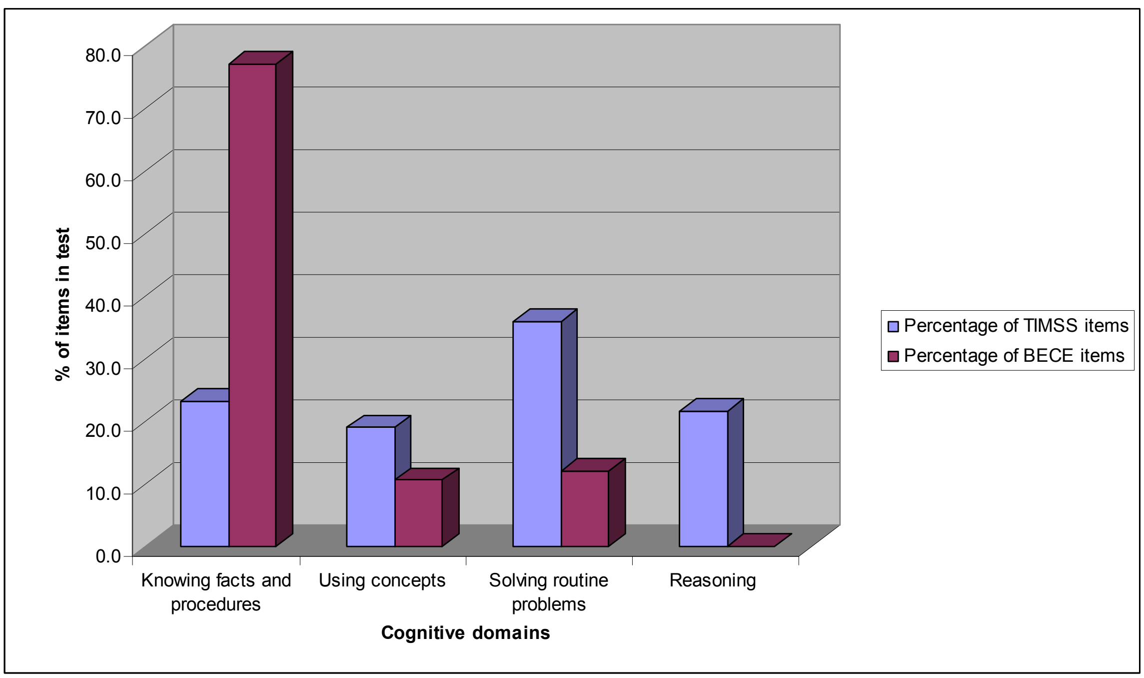
Besides the fact that the Ghanaian curriculum places a great deal of emphasis on number, most (77%) of the items in the BECE elicit responses in the lowest cognitive domain, i.e. 'knowledge of facts and procedures'. TIMSS had only 23.2 percent of items in this domain. A comparison of the other three cognitive domains shows differences between the BECE and TIMSS items. Table 6 shows the distribution of items in TIMSS and BECE Mathematics by cognitive domain

Table 6 Distribution of items in TIMSS and BECE Mathematics by cognitive domain

	Percentage of TIMSS items	Percentage of BECE items
Knowing facts and procedures	23.2	77.3
Using concepts	19.1	10.6
Solving routine problems	36.1	12.1
Reasoning	21.6	0

It is obvious from the table that there were differences in the proportion of items set in the cognitive domains. The BECE included only few items that required the students to solve routine problems. None of the BECE items can be classified as one that requires some higher level reasoning from the students. While the TIMSS devoted 36 and 21.6 percent of its items to 'solving routine problems' and 'reasoning' respectively, the BECE devoted only 12.1 percent to solving routine problems and did not include any item that tested reasoning. Figure 3 shows that besides knowing facts and procedures, the proportion of items in the other cognitive domains in TIMSS was higher than those in the BECE and the former emphasised problem solving.

Figure 3 Distribution of Mathematics Items by Cognitive Domain



Discussions

The poor performance of the Ghanaian students can be attributed largely to the lack of congruence between what is emphasized in the mathematics curriculum in Ghana and what is currently valued globally in school mathematics which the TIMSS was designed to measure. The

Ghanaian curriculum – textbook, syllabus and assessment – experienced by the students, who participated in the TIMSS-2003, placed a great deal of emphasis on number work and knowledge of facts and procedures.

It can be argued from the above analyses that the poor performance of the Ghanaian students in the TIMSS-2003 is largely a reflection of the nature of school mathematics curriculum that students have experienced in this country in the last two decades. The content of the textbooks and examinations continue to be dominated by commonalities of "*new math*". In fact Ghana is the only nation in the world today that has not moved its mathematics curriculum away from positions adopted in the 1960s.

But according to Fujita and Jones (2003) various studies, including the TIMSS have demonstrated that textbooks, together with documents for use in classrooms as teaching aids, such as resources for exercises, remain important tools in today's classrooms. TIMSS 1999 report indicate that textbooks play an important role in shaping the curriculum experiences of mathematics pupils in the five to 14 age range. This is particularly apparent in the first few years of formal education, since teachers are usually generalists, rather than mathematics specialists (IEA, 2001). In their study of textbooks in TIMSS countries, Valverde et al (2002) considered that textbooks mediate between intended and implemented curriculum and, as such, are important tools in today's classrooms.

The official mathematics schemes currently being used in Ghanaian basic schools, the Ghana Mathematics Series (GMS) textbooks and Teacher's Handbooks (CRDD, 1986, 1987) were products of the West African Regional Mathematics Programme. The series for primary schools were first published between 1975 and 1977 by the Ghana Ministry of Education. Although the manuscripts for the junior secondary books were completed as early as 1977, the books could not be printed until in 1987. The primary books were revised around the same period and this resulted in two major changes (Mereku, 1995). Firstly, it led to the inclusion of more instructions and explanations in the pupil's books. Secondly, the topics were aligned with those in the teacher's handbooks. The revision of the texts did not therefore bring about much change in the content, pedagogy and the complexity and quantity of new math language at the various levels of the scheme.

The new math curriculum materials including the GMS used in Ghana for three decades have been criticised for a number of reasons (Hawes, 1979; Wilson, 1992; Aldrich, 1969). These include criticisms that, (a) the contributors were dominated by academics who were not involved in school teaching; (b) the materials were directed primarily at students of high ability and hence the level of, and complexity of, language of the materials developed were too difficult for most students to understand; and finally, (c) the materials put a great deal of emphasis on the structures of mathematics and the use of precise mathematical language (particularly descriptive terminology) making it difficult for teachers to include enough learning tasks that would allow students to learn the use and applications of the subject.

But in spite of these criticisms, and the concern raised internationally for developing countries to "reconsider and make adjustments to the traditional mathematics curriculum – a phrase used in this context to embrace the 'new math' curriculum – (Howson and Wilson, 1986:14), the GMS

schemes have since remained in the nation's basic schools without a supplement. Therefore it did not come as a surprise when the report of a study commissioned by the Ghana Ministry of Education in 1993, pointed out that mathematics teaching in basic schools focuses on computation skills, learning of formulas, rote practice and teaching as telling. The principal investigator in this study, Kraft (1994:2) argued that

> the current syllabi, textbooks and teachers' handbooks do not meet the highest international standards, nor the current best thinking on sequence, learning and pedagogy and will not prepare Ghanaian students for the needs of the next century.

Conclusion

The limitations of the textbooks and the BECE discussed above point to the fact that the basic mathematics curriculum and the assessment processes that has remained in our schools for nearly three decades have little to offer the majority of pupils, particularly those who will not continue to learn mathematics after junior secondary. Anamuah-Mensah, et al (2004) observed that only 42 percent of Ghanaian JSS mathematics teachers used the mathematics textbooks as the main basis for mathematics lessons while 54 percent used it as a supplementary resource. Thus, the textbooks were used mainly by Ghanaian teachers as a supplement to other materials that teachers may have in their possession. This was not the case in most of the high performing countries such as Singapore, Korea and Japan, where the textbooks were the primary materials used in teaching the subject.

For effective learning, textbooks are very essential. Without good textbooks students will have little opportunity to engage in activities that will enable them to use concepts, solve problems and reason mathematically. The Curriculum Research and Development Division (CRDD) of the GES produces teaching syllabuses with specifically developed or recommended instructional activities, which are supplied to all schools. Even though the new teaching syllabuses in mathematics were supplied to schools in 2001, textbooks that match these syllabuses are yet to be supplied to schools four years after the syllabuses were reviewed.

Preparation is underway for the next TIMSS, which comes off in 2007. This is two years from now. In order to ensure there is improvement in the students' performance in the next TIMSS, the Ministry of Education and Sports should make available as soon as possible recommended textbooks and teacher's handbooks that match the revised syllabuses for mathematics. The Ministry of Education's new textbook policy, which provides schools with variety of textbooks on the same subject from different publishers, should also be vigorously pursued.

The GES, in collaboration with Mathematical Association of Ghana (MAG) and the teaching universities, should provide in-service education and training (INSET) for mathematics teachers on test development. The INSET should provide skills in construction of mathematics tests, especially multiple-choice and constructed response tests, to ensure most items in tests demand higher cognitive abilities – solving routine problems and reasoning. The BECE should also be revised to place appropriate emphasis on the various mathematics content and cognitive domains.

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Contribution of Continuous Assessment to Student Learning in Mathematics in Senior Secondary Schools: Case Study of the Birim South District

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The study seeks to find out whether continuous assessment contributes to students' performance mathematics. The objectives of this study were to find out whether; Students see continuous assessment as a motivating factor in their learning, there is any workload involved in filling of continuous assessment termly, assessment form and the components of continuous assessment comprising test/quizzes, class exercises, project work /home work, contribute to students' end of term examination performance. The study sample was selected from students in the second year of the five senior secondary schools in the Birim South District of the Eastern Region. Multi-stage stratified random sampling method was used to select three classes from each of the schools, yielding a total sample of two hundred and forty-five (245) students for the study. The performance scores of the students in Mathematics were analyzed for the study. The analysis of the results of the study showed that Students are actually motivated by continuous assessment to learn better, Teachers output was greatly affected by the filling and completion of continuous assessment record format. The study recommends among others that test/quizzes and project work/homework should be given high 40% each of the 30% continuous assessment weighting since these predict the occurrence of end of term examination scores. Another major recommendation from the study is that moderation should be carried out efficiently to make the scores students obtain acceptable by being valid and reliable.

Background of the study

Assessment may generally be used for summative or formative purposes. The summative type of assessment involves an overall assessment or decision concerning the worth of an educational programme. Formative assessment, on the other hand, is designed to help the teacher make effective teaching and learning decisions throughout the period of teaching. It provides continuous information or feedback to the teacher as well as to the student about their relative performance in teaching and learning. The information is then used for improving the quality of instruction.

In the classroom, assessment aims at determining the extent of students' mastery or competence over a body of knowledge and skills in a subject (Ebel and Frisbie, 1991). For several years, the educational systems of many nations were dominated by the one-short summative type assessment. The examination system in Ghana up to the time of the introduction of Continuous Assessment was also based purely on the single summative assessment. Students, teachers, parents and even textbooks were focused more on the single examination. Students were

coached to pass examinations so as to move up the education ladder. It was to counter the problems of the single summative examination that suggestions for a broader approach to assessment, which would be flexible and also provide valid and reliable results, were made (Akplu, 1989; Estey, 1992; Amedahe, 1994; cited in Bartels, 1994).

In continuous assessment, comprehensive data is collected on students' performance in a systematic manner throughout the entire period of teaching and learning and in a variety of situations with the purpose of awarding a mark that reflects the typical performance of the student over the period of instruction (Quansah, 1994). Continuous assessment provides cumulative records of the student, which can be used to extrapolate for a students’ final examinations- if, need be- in the event the student falls sick during examination time. Again it also spreads work throughout a course and so keep them busy rather than wait till end of year or course examinations which makes students too examination conscious.

Comments have been made on continuous assessment since its introduction in Ghanaian schools in 1987. (Quansah, 1994; Aidoo-Taylor, 1992) Some of the comments relate especially to the large number of exercises for collecting continuous assessment scores in a year, the non-uniformity of approach in its conduct and the large amount of work involved in the continuous assessment process in schools for conducting continuous assessment and whether continuous assessment can predict end of term examination scores.

Statement of the Problem

In the operation of continuous assessment there are variations in the approach to continuous assessment from school to school. A seventy percent (70%) score in one school for instance does not mean the same in another school. In view of this how therefore is continuous assessment contributing to students’ performance in schools in Ghana.

Purpose of the Study

The study seeks

1. to determine the relationship between performance in continuous assessment and the end of term examination performance of students in the senior secondary schools.
2. investigate whether students are really motivated to learn through continuous assessment.
3. to find the amount of work involved when teachers are filling continuous assessment termly assessment form

Research Questions

The study was designed to answer the following questions:

1. How do students see continuous assessment as a motivating factor in their learning?
2. What is the workload involved in filling of continuous assessment termly assessment forms?
3. What are the contributions of tests/quizzes, class exercises and project work/homework towards student’s performance in the end of term examinations?

4. Is there any relationship between continuous assessment component scores and end of term examination scores?
5. Can continuous assessment scores predict end of term examination scores?

Significance of Study

The findings from the study will enable school teachers have effective basis for assessing students. To the authorities especially school administrators, and the Ghana Education service personnel, it will serve as a guide to and design appropriate in service training programmes to update teachers' skills in assessment. To the stakeholders, it will give them insight on the activities in schools in terms of assessment in schools. Finally it will provide a fertile ground for further research.

Delimitation

Due to time and logistic problems, the study was limited to the Senior Secondary Schools in the Birim South District. The scope should have been all senior secondary schools in the Ghana, but due to the constraints mentioned earlier on, only senior secondary school students in the district mentioned were used for the study.

Limitations

The limitation was that the study focused only on Second Year Students since first year students had not had adequate and useful assessments during the period of the study. Secondly, since the third year students were preparing for their final examinations, they could not have time to contribute information for the study.

Methodology: Research Design

The descriptive analytical study research design was used. Descriptive studies are designed to obtain information concerning the current status of phenomena. The information gathered is directed towards the determination of the nature of a situation as it exists at the time of the study (Ary et al, 1990). The design often uses questionnaire, interviews and observations.

The design is useful in education research because as Charles (1988, p. 26) pointed out, 'it describes, clarify and interpret aspect of education as they presently exist. It is easy to conduct because data are fairly easily gathered and interpreted'.

Population and Sampling

The study was limited to the Senior Secondary Schools in the Birim South district. Out of the seven senior secondary schools in the district, five were used for the study, and one was used for the pilot study. The schools used for the study were as follows; School A: Oda Secondary School, School B: Akim Swedru Senior Secondary School, School C: Attafuah Secondary Technical School, School D: St. Francis Secondary Technical School, and School E: Akim Akroso Senior Secondary School

A multi-stage stratified random sample technique was used to select classes, subjects, subject teachers, students and their assessment records. Firstly, Eastern region was randomly selected from the number of regions in the country, followed by the choosing of the Birim South District

among the districts in the region. In selecting the schools this technique was used because it was recognized that there was internal homogeneity of students within the schools and classes, but heterogeneity between the schools. Stratification was used in sampling classes, subjects, and students because with such a design, the small sample from each of the schools (strata) will provide estimate with small sampling variance. Moreover, the stratification enable various analyses to be made separately for each school and each subject. The total number of second year students in the five schools was 650.

In order to make the sample representative, they were firstly stratified into courses; arts, science, agriculture, technical vocation, visual arts, and students were proportionally selected for the courses to form the sample. This is because as Som (1975, p. 89) said "with the probability proportional sampling method the size of the sample is made self-weighting and this leads to improvement in the efficiency of estimation since errors in the estimates can be statistically evaluated and controlled". Using the method, the analysis yielded a total sample size of 250 students representing 38% of the 650 students in the five schools.

Instruments

The instruments used to collect data for the study consisted of a questionnaire, interview schedule, documentary reports which included observing answer scripts, files which contain students' records of continuous assessment and examination sheets for the year, and a format for collecting assessment scores of students. An alpha reliability coefficient was calculated for each of the questionnaire on the basis of the try-out data. The teachers' questionnaire had a reliability of 0.91, and the students' questionnaire had a reliability of 0.90.

The interview schedule required teachers to answer questions on how their work schedule was affected by the conducting and recording of scores collected from students as their continuous assessment performances.

Data Collection Procedure

A letter of introduction was collected from the Acting Head of Department of Psychology and Education of the University of Education, Winneba. The letter was given to the heads of the research schools who in turn informed their teachers and students of the study. A time was fixed to meet the teachers.

The questionnaires were administered and the one for the students were explained to them before being passed out to them. The questionnaires were collected back the same day. Student's assessment records of the selected students were requested for and the scores in the assessment record books were compared with scores in students' exercise books to see whether the correct scores were recorded in the assessment books.

In all, 245 students took part in the study, representing about 98% response rate. The response rate for the teachers was 100%. A pilot study was conducted at Achiase Senior Secondary School.

Data Analysis Procedure

The significance level used for the study (both research questions and hypotheses) was 0.05.The level was adopted because as Som (1975, p. 15) has claimed "researches involving behavioural

Science tend to be complex to the extent that it is unrealistic to set and alpha at any level lower than 0.05”. Pearson’s correlation coefficient, multiple regressions were used for the analyses.

Analyses of Test Items

Items for class exercises, quizzes and test, project work/ homework and end of term examination were sampled from a pile of questions collected from the headmasters’ offices. These were observed and compared with the content of the selected subject used. This was done to establish the validity of the items given to the students and also to find out if there are any relationship between them. The items were matched with the West Africa Examination Council (WAEC) items to find out if teachers usually use items from past questions to assess their students. The items collected were analysed to see the degree of congruence that existed between them to the extent that they measure the same or at least similar skills and abilities or otherwise. Again the way the scores obtained by students in continuous assessment are recorded were also observed to find out if the recordings were properly done. For confidentiality, the items were not included in this study.

Findings and Discussions

Students’ Perception of continuous assessment as a motivating factor in their learning

The results of frequency counts of the students’ responses indicating the extent of their agreement to continuous assessment as a motivating factor in their learning are presented in Table 1.

Table 1 Students’ Perception of Continuous Assessment as Learning Motivation Factor

Responses	Observed Cases	Percentages
Agreed	201	82.0
Undecided	21	8.6
Disagreed	23	9.4
Total	245	100

Of the 245 respondents who participated in the study, 82.0% (201) agreed that continuous assessment motivated them to learn. 8.6% (21) were undecided; and 9.4% (23) disagreed that continuous assessment motivated them to learn; i.e. that continuous assessment did not motivate them to learn. The results indicate that a substantial number of students, 205, perceived continuous assessment as a motivating factor in their learning.

Amount of work involved in filling of continuous assessment termly assessment forms

To investigate the amount of work involved in filling of continuous assessment termly assessment forms, a document analysis was carried out on the continuous assessment record keeping documents.

To complete students’ termly assessment reports, a teacher was required to complete a 20-columns form for continuous assessment. The teacher was expected to do the following for each student in the record book:

a). Write the name of the student

b). Enter marks as follows:

Assignments for continuous assessment (11 in all), Total mark for all continuous assessment components for the term, which is equal to 100% (one total mark), Total mark for all continuous assessment components for the term, which is equal to 100 %.(one total mark), Scaled down total from 100% to 30%. (Once), enter one end of term examination mark of 70%, Addition of continuous assessment score of 30% to end of term examination score of 70%. (Once), fill the last column for the position of the student in the class, finally the teacher finds the average performance score for the class and enters at the appropriate space provided at the top of the table.

Going through the above, the teacher records a total of 20 marks for each student per term. For a year the total marks for the three terms per subject per student per year becomes $20 \times 3 = 60$ marks. Table 2 shows the number of marks recorded by teachers in five classes (A to E) in a school.

Table 2 Distribution of marks filled by teachers in the selected schools

Schools	No. of students	No. of Scores Recorded	Totals
A	83	83×60	4980
B	61	61×60	3660
C	33	33×60	1980
D	35	35×60	2100
E	33	33×60	1980

Table 2 indicates that, School A with the greater number of students (83) had, the teacher recording as many as 4980 marks for the year, teachers from school B recorded 3660 marks for each student. In school D, teachers recorded 2100 marks for each student and schools C and E recorded 1980 marks for each student a year respectively.

The analysis shows that in schools where the number of students in class is very large, the teacher will have to record more scores. The situation will be more tedious if a teacher is teaching more than one subject with very large class size. This will tend to give the teacher a lot of work to do in class.

From the interviews with teachers, some of them remarked that they spent greater part of their time recording marks both at school and at home. Even some continue with the recording during the holidays. One remarked that due to the number of hours I spend in recording these marks, the number of student-teacher contact hours is reduced by the fact that continuous assessment takes a lot of time and severely cuts into the amount of time required for effective teaching and learning.

Another also remarked that ‘a lot of stress is put on him when it comes to recording of continuous assessment marks in the record books’.

From the foregoing, teachers are affected with high stress in compiling and recording marks, which induces high stress on teachers. Teachers therefore use class time and part of holidays in recording continuous assessment marks, which increases the stress, and fatigue on teachers.

Contributions of tests/quizzes, class exercises and project work/homework towards students' performance in the end of term examinations

In this study, the researcher sought to find out whether or not tests/quizzes, class exercises and project work/homework contributed towards students' performance in the end of term examinations. Table 3 shows the multiple regressions analyses of Students' Continuous Assessment (Tests/quizzes, class exercises, project work/ home work) and End of Term Examination Performance Scores in Mathematics.

Table 3 Multiple Regression Analyses of Students' Continuous Assessment (Tests/quizzes, class exercises, project work/ home work) and End of Term Examination Performance Scores in Mathematics

Group	Size	Multiple R	R^2	$R^2 \times 100$	Sig. F
All Schools	245	.139	.019	1.19	.187
School A	83	.003	.135	13.5	.874
School B	61	.077	.006	.6	.953
School C	33	.373	.139	13.9	.222
School D	35	.322	.104	10.4	.327
School E	33	.429	.184	18.4	.112

The table gives the multiple regression analysis for the joint contribution of test/quizzes, class exercises, and project work/homework to the end of term examination scores. In the table, R^2 gives the proportion of the variance of the scores in end of term examination, which were the effect of the linear combination of test/quizzes, class exercises and project work/homework. From the table, the R^2 for all the Schools showed that .019 of the variance of the end of term examination was due to the linear combination of test/quizzes, class exercises and project work/homework. This meant that 1.19% of the scores that a student obtained in the end of term examination were due to the joint effect of test/quizzes, class exercises and project work/homework. Column 5 shows the percentage contribution of the components to end of term examinations.

At the school level, the joint contributions were School A (13.59%), School B (0.6%), School C (13.9%), School D (10.4%) and School E (18.4%). At the 0.05 level of significance, none of the groups showed statistical significance.

The different scores for the subject could be attributed to the variation in the continuous assessment components and the end of term examinations scores. Due to this, there are bound to be variations in the approach of assessing students in schools. Comparing performance of students in one school to the performance of students in other schools cannot be effectively made since teachers in respective schools have varying standards in using continuous assessment.

The variations may be due to the type of items given and how continuous assessment is conducted in the schools. Continuous assessment is expected to offer students the chance to exhibit their learning over a wide area of the syllabus. Questions must therefore be set to cover a wide area of the syllabus in order to measure the true ability of the student. When questions are selected from past examination question papers either in test/quizzes, class exercises, project work/homework and used in end of term examinations, the student is not challenged to learn

over a wider area of the syllabus. In this case, the marks students obtain do not indicate their performance over the syllabus. Some of the items too were observed to be poorly constructed. Poorly constructed tests or tests taken from published examinations in this case, have low content validity with respect to expected achievement over the school syllabus that was taught in class. Students' scores are therefore meaningless since they cannot be referenced to achievement over the syllabus. This situation can be looked at the way continuous assessment is conducted in the schools more especially School E.

Though having all schools adopt one way of assessing may be difficult but at least common guidelines can be developed for all to follow to avoid variation in the conduct of continuous assessment. This may at least ensure consistency in the skills and abilities that continuous assessment seeks to measure and improve its predictive value.

Relationship between continuous assessment component scores and end of term examination scores

The researcher sought to find out whether or not there was any relationship between continuous assessment scores and students' performance in the end of term examinations. Table 4 presents the relationships between continuous assessment component scores and end of term examination scores.

Table 4 Correlation Analyses for scores in Tests/quizzes (X_1), Class Exercises,(X_2) project work/homework (X_3) and End of Term Examination Scores (Y) in mathematics

Groups	Size	X_1 Y	X_2 Y	X_3 Y
All Schools	245	.084	.91	.009
School A	83	.05	.139	.040
School B	61	.045	.053	.009
School C	33	.230	.024	.214
School D	35	.195	.190	.238
School E	33	.085	.373**	.180

** Significant at α=0.05,

The relationship between test/quizzes (X_1) and end of term examinations (Y) is found in Tables 4, column 3. From the table, all the relationships were positive for mathematics.

The relationship was positive for All Schools (.084) and the rest of the Schools with School C (.230) having the highest correlation coefficient. None of the relationship was significant as found in Table 4.

The non-zero relationship shows that some form of relationship exists between the variables. This means high scores on test/quizzes were associated with high scores on end of term examinations. The results show that none of the relationships was significant. A careful examination of the items showed that some questions for test/quizzes were repeated in the end of term examinations. Though with this situation, the performance of students should have brought a high correlation coefficient this was not observed. A probable explanation may be that those

who performed poorly on the test/quizzes improved on their end of term examination performance and those who did well on the test/quizzes did not put in much effort during the end of term examination. This needs to be investigated since “one might not infer caution from correlation” (Kerlinger and Pedhazur, 1973, p 16).

On how scores were recorded it was observed that some of the teachers never organized class test for the students but had scores recorded for their students. Some also divided end of term examination scores into various segment meant for the continuous assessment components and recorded the scores under various component of continuous assessment. Added to this problem was how teachers inflated mark in test/quizzes when the record books were observed.

The relationship between class exercises (X_2) and end of term examinations (Y) is found in Table 4, column 4.

There was a very high relationship for All Schools (.91) as found in column 4 in Table 4. All the relationships were positive with School E (.375) recording a significant relationship between the variables.

Sample items showed that the end of term examinations were selected from past WAEC examinations papers. These students might have seen these items before taking the examination and this did not make the items challenging for the students. Upon comparing items from class exercises and the end of term examinations, they were found to vary. Across the schools too, the variations were large and these contributed to the variations in the correlation coefficient as was observed between .91 for All the School and .024 for School C.

In general, about one-half of the end of term examinations items given for class exercise in All the Schools except in School B was in the class exercises. School B had the items in class exercises different from the items in the end of term examination. Items found on the end of term examination did contain some of the items on the WEAC examinations. Again the variation of scores can also be attributed to the fact that when the records cards/forms were observed against students work it was observed that teachers did not give any internal assessment but still recorded marks for their students in continuous assessment.

The relationship between project work/home (X_3) and end of term examinations (Y) is found in Tables 5, column 5. From the tables all the relationships were positive for all the schools.

In column 6 of Table 5, the correlation coefficient was weak for all the Schools and none was significant.

From the correlation analyses relating the scores from continuous assessment and end of term examinations scores would not be unrealistic, but the principle underlying the procedure is the maximization of the reliability of the total scores, and not mere correlation, the results as found above is taken meaningful. Further it is noted that there were a variety of measurement techniques employed by some of the teachers, the desired reliability of scores can only be achieved with reference to individual cases and not the “across the board” type of proportion employed by some institutions. (Bartels, 1994).

Extent to which continuous assessment scores predict end of term examination scores

Analyses of variances was used to examine the predictive abilities of the continuous assessment components to the end of term examinations scores. Table 5 presents the ANOVA description of the data, which indicates the predictive ability of the variables in the analysis.

The ANOVA description shown in Tables 5, indicates how the components of continuous assessment scores predict the end of term examination scores. Column 8 indicates which of the components actually predicted the end of term examination from the results or scores gathered and used for the analysis. The analyses for each of the subjects used for the study are as follows.

Table 5 ANOVA description of Relationship between Continuous Assessment and End of Term Examinations Scores in Mathematics

Schools		SS	df	MS	F	Sig F	Predictors
	Regression	664.860	3	221.62	1.61	.18	Test/
All	Residual	33789.124	242	137.35			Quizzes Class exercises
Schools	Totals	34453.984	245				Project work /Homework
	Regression	37.02	2	18.53	.15	.84	Test/
School A	Residual	11692.194	81	137.55			Quizzes Class exercises
	Totals		83	11729.2			Project work /Homework
	Regression	44.439	3	14.813	.11	.95	Test/quizzes
School B	Residual	7511.323	58	131.778			Project work /Homework
	Totals	7555.770	61				
	Regression	551.436	3	183.812	1.81	.22	Test/
School C	Residual	3412.802	30	119.683	2		Quizzes Class exercises
	Totals	3964.242	33				Project work /Homework
	Regression	539.378	3	179.982	1.19	.37	Test/
School D	Residual	4656.222	32	150.265	7		Quizzes Class exercises
	Totals	5197.600	35				Project work /Homework
	Regression	780.847	3	260.282	2.18	. 1 2	Test/
School E	Residual	3460.669	30	119.330	1		Quizzes Class exercises
	Totals	4241.515	33				Project work/Homework

From Table 5, apart from School B where the end of term examination was predicted by project work/homework and test/quizzes, the end of term examination results for the rest of the groups were predicted by the components of continuous assessment. Even though the data shows test/quizzes and project work/homework predicting the end of term examinations scores in all the schools, it was not significant. This therefore means that efforts should be made to improve the quality of how scores of students in class exercises are obtained to bring about predictive ability of class exercises to the end of term examinations.

On the whole, it was observed that class exercises did not predict end of term examination in School B. This indication shows that the mode of giving class exercises in school B was a problem. On observing items from school B it came out that about one half of the end of term examination always contain items given to students as class exercises. Students might have had prior knowledge of the questions before taking the end of term examination and so are not

challenged to exhibit the actual ability or skills they posses and as such the scores could not predict the end of term examination scores.

Again it was observed that students presented very similar or sometimes the same material as others in class exercises and in project work/homework when answered scripts were observed. This means that students copied from each other. Copying from friends negates the essence of independent work. The scores students obtain from copied work are obviously not reliable indicators of their personal study and personal effort. This problem shows the lack of independence on the part of students in responding to class assignments and examinations. This largely may be due to the fact that there is no strict and proper supervision from teachers and administrators in the operation of continuous assessment.

From the analyses done, the following are the findings:

1. Continuous assessment has a motivating effect on students' learning. Eighty-two percent of students sampled agreed that they were really motivated to learn through continuous assessment.
2. A lot of stress is put on teachers by filling and completing the termly assessment records.
3. The performance in end of term examinations could be predicted by test/quizzes and project work/homework scores.
4. None of the relationship between continuous assessment scores and end of term examination scores was significant.

Evaluation of findings

Students were found to be motivated by continuous assessment to learn as revealed by the study. This calls for the implementers of continuous assessment to look at all the facets of continuous assessment and to see to how to effectively use all of it because continuous assessment has been found to be diagnostic, guidance oriented and as such feedback seems to be very crucial for effective implementation. This will therefore, if properly effected motivate students a lot as advocated by Etsey (1992).

A lot of stress is put on teachers, as found in the study, due the filling of assessment form of students some teachers were found to be dishonest when the scores entered in the assessment forms were compared with scores in student's exercise books. Some of such dishonest behaviour is as follows: Some teachers divided one exercise they gave students into sections and recorded the scores of each of the sections against each of the assessment modes used in continuous assessment. For example, a ten-question exercise was divided as follows; the first three questions were scored and recorded as class tests/quizzes score, the score for the next three questions was recorded against class assignment, and the score for the last four questions was recorded for project work/homework. The total score was then recorded as continuous assessment score for the student for the term. Further, scores recorded in students' end of term Report Books as continuous assessment scores were found to be inflated when compared to the actual scores in their exercise books.

The teachers involved could not assign any reason for the differences in the scores. Some of the teachers also did not organize any internal assessment but still recorded marks for their students on continuous assessment at the end of term. The critical issue is how to evolve a system to check teachers' dishonest behaviour and to make sure they follow the laid down guidelines for

the operation of continuous assessment. This calls for a critical look, in the view of the researcher, at how teachers are overloaded in terms of his/her work input in the conduct of continuous assessment. The researcher therefore suggest that in view of the fact that a lot of stress was put on the teacher when filling the assessment forms and in order to reduce stress on teaches due heavy workload there should be a reduction in the number of exercises teachers are to give students.

In predicting the outcome of end of term examinations, indication from the entries showed that apart from School B where test/quizzes and project work/homework predicted the end term examination scores, all the schools as well as the individual schools had all the three variables (component) predicting their end of term examinations.

The implication here is that some of the variables showed some relationship and others did not. Reasons for the trend may be due to certain factors not dealt with in this study, which might affect the results.

The conclusion is that test/quizzes and project work/homework scores can be used to predict the performance of students in the end of term examination. In the view of such revelation made in the study the researcher thinks test/quizzes and project work/home work should be encouraged very much by giving it a high weighting whereas class exercises should be given a small weight in the conduct of continuous assessment, for as Palmer (1970) warns that “continuous assessment on its own does not ensure valid assessment, the teacher needs to define the objectives with some exactness and then gauge what is being measured and in what proportion”.

Conclusions

The following conclusions are drawn from the results of the study. The study revealed from the sample that continuous assessment has a motivating effect on students’ learning. From the study, eighty-two percent (82%) of the students sampled agreed that they were really motivated to learn through continuous assessment. Therefore students should be given guidance in order letting students know how important continuous assessment is in their learning and the effect it has on their end of their course.

The study revealed further that a lot of stress is put on teachers by filling and completing the termly assessment records. This suggests that the numbers of number of columns in the termly assessment form are many and needs to be revised. In revising it, it means reducing the number of columns in order to reduce teachers’ amount of work in filling and completing the assessment form. This therefore calls for reduction in the number of exercises given to students by teachers as stipulated in the policy.

The research brought to light that test/quizzes and project work/homework scores of students could predict the end of term performance. In view of this, many emphases should in terms of supervision, constructing test items and administration of exercises, be placed on test/quizzes and project work/homework in deciding the performance of students at the end of the term.

Limitations of the Study

This study is not immune from the general limitation usually inherent in research based on the use of instruments (questionnaire) to collect data based on the respondent reading before writing,

the use of questionnaire in the survey could definitely have led to some faking of responses especially as some teachers and students would disinterestedly have filled the questionnaires.

The use of the test scores too present a limitation because the scores cannot be said to be reliable one as teachers, as revealed in the study, did not construct good items to elicit the right responses, teachers dishonest behaviour, students copying etc. which cannot be used to take a right decision.

Time and financial constraints allowed only the use of secondary schools in the Birim South District of the Eastern region.

Recommendations

The following recommendations were made: It is recommended from the study that since test/quizzes and project work/homework could predict students' end of term examinations scores from the study in continuous assessment, test/quizzes and project work/homework should be given higher weighting than class exercises if class exercises will be used at all. It is recommended that test/quizzes and project work/homework be given a weighting of 40% each out of the 30% continuous assessment weight. In so doing much emphasis will be placed on two exercises to enhance performance.

The researcher recommends that moderation of items generated in schools should be encouraged by the schools. This will help teachers come out with well constructed and reliable test items. This can be done by the schools forming committees that will occasionally moderate items generated internally in the schools. This will make scores students obtain in test more reliable and valid.

In ensuring valid continuous assessment goals, effective supervision should be carried out by school administrators as well as officers in the district education offices, who are well informed about the procedure of continuous assessment, to ensure that continuous assessment procedures are followed by all teachers. This will serve as a means of standardisation of continuous assessment scores and form the basis for comparison between schools and students. By so doing, sores received for schools can be said to be reliable and valid.

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Constructivism and Mathematics Education in Ghana

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Abstract

Mathematics is a subject found in every school Curriculum in almost every country. Here in Ghana, mathematics is a compulsory subject in both the basic education (i.e. primary and junior secondary) and senior secondary curricula. This paper argues that in spite of the desire of mathematics educators in Ghana to pursue a constructivist agenda with regard to the teaching and learning of mathematics, mathematics teachers at the basic and senior secondary levels continue to place undue emphasis on memorisation and 'imitation' rather than understanding and explaining. The difficulties involved in making the switch from the transmission approach to mathematics teaching to activity-based approaches include counteracting the effect of an examination system which encourages rote learning and recall of facts, lack of expertise among teachers of mathematics and teachers' resistance to change.

Mathematics is a subject found in every school curriculum in almost every country. In Ghana, for example mathematics is a compulsory subject in both the basic school and senior secondary school curricula. All pupils in basic and senior secondary schools must study mathematics. In this paper, an attempt is made to answer the question: What mathematics should be taught in Ghanaian schools? In other words, what should the Ghanaian school mathematics curricula, look like?

To answer either of these questions, it is relevant to examine the philosophy of school mathematics generally because of the strong link between philosophy of mathematics and the mathematics curriculum. Indeed as Ernest (1991) observes, a number of studies (e.g. Thompson, 1984; Raymond, 1993) have confirmed the powerful impact curriculum developers' and teachers' personal conceptions of mathematics have on the mathematics curriculum. Thompson for example, records:

> The observed consistency between the teachers' professed conceptions of mathematics and the way they typically presented the content strongly suggest that the teachers' views, beliefs and preferences about mathematics do influence their instructional practices (Thompson, 1984:125).

If the personal philosophies of those in authority (e.g. curriculum developers), play a vital role in pedagogical and epistemological issues in mathematics education (Koss and Marks, 1994), then it is important to discuss the various philosophies of mathematics in any discussion of the nature of mathematics, the way it is taught and learnt, and the way it is assessed in schools today.

[2] Jonathan.

Davis and Hersh (1981) discuss the foundations of mathematics and present a number of philosophies. Among these are the three major philosophies of mathematics which dominated the 'foundations' debate in the early part of the twentieth century. These philosophies are Platonism, Formalism and Constructivism.

Briefly, Platonists believe that mathematical objects exist and that their existence is an objective fact quite independent of our knowledge of them. These objects, they claim, are real definite objects with definite properties, some known, some unknown. In other words, any meaningful question about a mathematical object has a definite answer, whether we are able to determine it or not. A mathematician in this school is an empirical scientist. He cannot invent anything because it is already there. All he can do is discover! Thus Thom (1975), a Platonist, calls on mathematicians to affirm that mathematical forms indeed have an existence that is independent of the mind considering them. In other words, mathematical knowledge is "neutral", culture-free and absolute!

Formalists, on the other hand, do not believe in the existence of mathematical objects. They believe that mathematics just consists of anxioms, definitions and theorems. They see mathematics as a science of rigorous proofs. Any logical truth must have a starting point - the axiom upon which the theorem is built. The anxioms may be false or true but, to the formalist, that is not important. What is important is the valid logical deduction that can be made from the axiom. Perhaps the most influential example of formalism as a style in mathematical exposition was the writing of Bourbaki, which had a tremendous influence all over the world in the 1950s and 1960s. This period marked the construction of 'modern mathematics' as an academic content unified by the set theoretic ideas (Dowling, 1990).

A radically different alternative to platonism and Formalism is constructivism. Constructivists believe that mathematics does not grow through a number of indubitable established theorems, but through the incessant improvement of guesses by speculation and criticism. Lakatos (1962), for example, argued that mathematics is not infallible and like all the natural sciences, it too grows from criticism and correction of theories which are never entirely free of ambiguity or the possibility of error or oversight. Starting from a problem, there is a simultaneous search for proofs and counter examples. New proofs explain old counter examples, new counter examples undermine old proofs. Lakatos, however, did not actually carry out a programme of reconstructing the philosophy of mathematics with a fallibilist epistemology. It is also uncertain, as to what would be the "objects" of Lakatos' informal mathematics.

In spite of the inability of any of these philosophies to establish an 'undisputed' foundation of mathematics, they have very important implication for mathematics education not only because of the link between pedagogy and philosophy of mathematics, but the aims of mathematics education are influenced by these philosophies. For example, Platonists view mathematics as a set of indubitable truths, a supreme achievement of humankind and an intrinsically valuable treasure. Based on these values, the main aim for mathematics education is the transmission of mathematical knowledge as a good in itself. In other words, mathematical knowledge is good because it trains the mind and not because it is used in our everyday lives. Indeed, Plato (1941) believed that the pure disciplines such as mathematics had the "power of turning the soul's eyes from the material world to the objects of pure thought" (p.23). Also great mathematicians such as Frege and Russel, in their discussion of the nature of mathematics did not refer to anything other than pure mathematical knowledge. The values of purity were illustrated by Halmos (1985)

with the title of his paper: 'Applied mathematics is Bad Mathematics', in which he distinguishes the pure aesthetic of the 'knower' from the practical concerns of the 'doer'.

Here, school mathematics is understood to be a pure, hierarchically structured self-subsistence body of objective knowledge. Higher up the hierarchy, mathematics becomes increasingly pure, rigorous and abstract. Pupils are encouraged to climb up this hierarchy as far as possible, according to their mathematical ability!. This position is somehow shared by Formalist too. It is perhaps no exaggeration to suggest that mathematics education in Ghana is heavily influenced by Platonism and Formalism although the perceived usefulness of mathematics is one of the most popular reasons cited by Ghanaian mathematics teachers for the teaching and learning of mathematics in schools (Fletcher, 1995).

Indeed, irrespective of the level at which mathematics is taught, the role of the Ghanaian mathematics teacher has almost always been that of a lecturer and explainer, communicating the structure of mathematics 'systematically'. The teaching style is simple. The teacher explains, illustrates, demonstrates and in some cases gives notes on procedures and examples. The pupils are led deductively through small steps and closed questions to the principle being considered. A common pattern, particularly with lower attaining pupils, is to show a few examples on the chalkboard at the start of the lesson and set similar exercises for the pupils to work on their own.

At its best, and given pupils who are sufficiently motivated, this style of teaching achieves what it is set out to do - that is, prepare the pupils for examinations. At the worst, it becomes direct 'telling how' by the teacher, followed by in comprehension on the part of the pupils. What is lacking in this approach, even at its best, is a sense of genuine enquiry, or any stimulus to curiosity or appeal to the imagination (Ernest, 1991).

Accepting this view of mathematics implies a tendency to bring pupils to see mathematics as a deductive process. Here it is the method that is of central significance, and provided that it is thoroughly taught, learned and tested by repeated exercises, mathematics is thought to be 'successfully' conveyed. In terms of assessment, this view of mathematics overemphasizes summative assessment through 'external' examinations at the expense of formative assessment, as competition in examinations in seen as providing a means of identifying the 'best' mathematician (Ernest, op cit). Indeed it is the belief of many Ghanaian teachers that the best preparation for examinations is direct practice of the kind of questions that are eventually asked (Kanbogtah, 1999). It is therefore hardly surprising that the examination system in Ghana tends to drive the school curriculum instead of being informed by the latter. If a topic is never be examined by the examination body, it is never taught! Amongst (mathematics) educators there is now considerable skepticism about the above perspective of mathematics, though institutionally, it remains a powerful lobby (Lerman, 1993).

Surely, if mathematics education is about the overall development of the growing human being, as it should be, then other factors such as the development of the child's creativity are important. These factors may be better achieved through the development of the child as an autonomous enquirer and knower of mathematics and the fostering of the child's confidence, positive attitude and self-esteem, with regard to mathematics, than through the learning of theorems and formulae in mathematics. Adopting the constructivist philosophy of mathematics education appears to be the way forward.

Constructivism and Mathematics Education

The transmission view of teaching attributes two general functions to the teacher's words and actions. They can carry meanings in and of themselves that are waiting to be apprehended by pupils, and they can serve to draw pupils' attention to mathematical structures in the environment. Constructivism challenges this assumption that meaning resides in words, actions and objects independent of the interpreter (Von Glasserfield, 1991).

Brieter (1985) had earlier observed that a core belief in contemporary approaches to learning is that knowledge and cognitive strategies are actively constructed by the learner. This observation has solid epistemological foundation and is generally consistent with literature (e.g. Carpenter et al. 1988; Jaworski; 1994) that documents pupils' cognitive development in specific areas of mathematics, particularly their misconceptions. It consequently has important implications for instruction and assessment in mathematics. As mentioned above, the seemingly obvious assumption that the goal of instruction is to transmit knowledge to pupils stand in flat contradiction to the contention that students construct knowledge for themselves by restructuring their internal cognitive structures.

In constructivism, teachers and pupils are viewed as active meaning makers who continually give contextually based meanings to each others' words and actions as they interact. From this perspective, mathematical structures are not perceived, intuited or taken in but are constructed by reflectively abstracting from and re-organising sensorimotor and conceptual activity. Thus the mathematical structures that the teacher 'sees' are considered to be the product of his or her own conceptual activity and could be different form those of the pupils. (Von Glasserfield, 1991). Consequently, the teacher cannot be said to be a transmitter of such structures nor can he or she build any structures for pupils. The teacher's role here is viewed as that of a 'consultant architect'.

Without overplaying the above metaphor, an architect must know the site or ground on which the structure will be built and must know in some detail the nature of the structure to be built and the theories which underlie the soundness of such structures. In the case of the mathematics teacher, he or she must know the nature of the current mathematical knowledge base of the student, and must have insights into the knowledge structures which can grow from such a base.

The term "consultant" has deliberately been appended to the term "architect" (in characterising the teacher's role) to suggest that the individual pupil is in charge of his or her knowledge building. The teacher provides ideas, activities, insights and feedback which should help the pupil build this knowledge. But how can the teacher communicate these ideas if he or she does not have the same mathematical structures as those of the pupils? How can constructivism explain situations in which the pupil 'understands' what is being 'taught' if the teacher and the pupil construct their own mathematical meanings?

Fletcher (1992) argues that although instruction clearly affects what pupils learn, it does not determine it. Pupils are not passive recipients of knowledge; they interpret it, put structure on it and assimilate it in the light of their own framework. Indeed, as O'Reilly (1990) points out, children enter school with highly developed informal systems of arithmetic and before they receive any formal instruction in arithmetic, they can solve simple addition and subtraction word problems. These solutions arguably suggest reasonably well developed conceptions of addition and subtraction even though the children have not learnt the formal terminology associated with the operation.

Jaworski (1994) also explains that the reason for successful communication between teachers and pupils is that teachers and pupils can negotiate meanings of actions and words as they interact. Consequently, teachers and pupils may share meanings of actions and words not through transmission of knowledge but through 'negotiation'.

Perhaps, one reason why the constructivist paradigm should be seriously considered as an alternative to the transmission view instruction is that a fundamental goal of mathematics instruction is, or should be, to help students build structures that are more complex, powerful and abstract than those they possess before instruction. The teacher's role here cannot be merely to convey to pupils information about mathematics but to facilitate profound cognitive restructuring through negotiation of meanings of mathematical activities.

A number of researchers (eg. Carpenter et al, 1988; Simon and Schifter, 1993) have reported findings which seem to confirm that the constructivist approach can lead to better communication of mathematical ideas by pupils. For example, Simon and Schifter (op.cit) studied the effects of a constructivist - oriented in-service programme for teachers on their students' learning of mathematics. The researchers found that, along with transformations in the nature and quality of mathematics activity in the classroom, students' beliefs about learning mathematics changed and their attitudes towards mathematics improved. The students involved in the research were encouraged to discuss their mathematical problems and solutions among themselves. In other words, emphasis was placed on encouraging students to verbalise mathematical thinking, to explain and justify mathematical solutions and to learn to resolve complicating points of view.

In fact, 'radical' constructivist (see von Glaserfeld, 1983, 1991) argue that any suggested interpretation or solution to a mathematical problem (preferably posed by the pupil) is acceptable provided it indicates that the pupil has made appropriate suggestions. By focusing on the ways and processes by which pupils construct their own mathematics or mathematical 'realities; constructivism attempts to demystify mathematics and make it more accessible to all pupils. This process may be facilitated by encouraging pupils to pose and solve mathematical problems in social contexts and to discuss mathematics embedded in their own lives and environments.

Indeed if pupils are to be empowered and given greater control over their own lives, then as Fletcher (1997) points out, they should be encouraged to choose their own areas of study in mathematics and should also be encouraged to work in groups and generate mathematical problems. In furtherance of these aims, school mathematics must be embedded in pupils' cultures and the reality of their situation, engaging them to appropriate it for themselves. It is in this way that knowledge of mathematics can help equip pupils with thinking tools (Norwood, 1999).

This is in line with social constructivists' advice to mathematics teachers to take into account the social interactions as well as the power structure in the he classroom if they are to switch from the transmission approach to mathematics teaching to the constructivists approach. Jaworski (1994), a social constructivist writes:

> The construction of knowledge in the classroom goes beyond interaction between teacher and students, to wider interaction between students themselves in the social and cultural environment and beyond. It seems crucial for mathematics teachers to be aware of how mathematical learning might be linked to language, social interaction and cultural context (Jaworski, op.cit:128).

Schemes such as the Kent Mathematics Project (KMP) and the secondary Mathematics Individualized Learning Experiment (SMILE), both in the U.K., are arguably based on constructivists' view of mathematics. For example, among the aims of the KMP is to:

> ... provide a unique course in mathematics for each individual child, using materials suitable for all abilities (sic) of children ..., to give the teacher the opportunity to use his or her own skills at diagnosing weaknesses, helping children to develop concepts and establishing co-operative rather than teacher-dominated relationships ... (and) to provide a system in which children will accept responsibility for most of their own learning (Kent Mathematics Project, 1978:6).

The SMILE is in many respects similar to KMP and indeed was originally an offshoot of it, although it is more of computer work as well as well as investigative work. The emphasis (in SMILE) is on the pupil learning from activities that they carry on independently, using the teacher as one resource among many, and not for formal teaching and teacher directed activities. This is in contrast with the transmission view of instruction where teachers are seen as authorities possessing all the 'answers'.

Teachers with the transmission view of instruction ask students to discard informal and previously learnt methods in favour of the methods the pupils are currently studying. For example, asking pupils to use number facts exclusively, rather than informal counting - on strategies, may subtly suggest to pupils that counting is no longer part of the domain of mathematics because it is no longer acceptable in mathematics class. If pupils discount their prior knowledge of mathematics and their informal solution processes, they are discounting a proportion of their achievement in mathematics. A resulting conjecture is that this will lower their confidence, especially for pupils who have difficulty with mathematics and consequently affect their mathematical attainment (Fletcher, 1997).

Another scheme which was based on, and still uses, the constructivists paradigm is the international Mathematics In Society Project (MISP). The project started in the he early 1980s and continued to be developed in the late 80s and the early 90s in the UK, USA and Australia mainly for the secondary school level. In general MISP relates mathematics to the "real world", albeit the nature of "real world" can be seen from different perspectives. A great deal of innovative work has been completed through MISP.

Here in Ghana, several attempts have been made, with very little success, to encourage mathematics teachers to switch from the transmission approach to mathematics teaching to activity-based approaches. The difficulties involved in making the switch include counteracting the effect of an examination system which encourages rote learning and recall of facts, lack of expertise among teachers of mathematics and teacher's resistance to change which stems mainly from their lack of content and pedagogic content knowledge in mathematics. However, the newly introduced Whole School Development (WSD) concept promises to make some impact by providing a way of encouraging teachers to make this important switch (GES Teacher education Division, 1999).

The WSD is an intervention process funded by the British Council and is designed among other things to improve the quality of teaching and learning in Ghanaian primary schools. This is done through the provision of support to promote the development of competent and motivated teachers in the areas of literacy (mainly English language), numeracy (ie mathematics) and problem solving (involving the application of scientific principles). A number of workshops have been organised by the Teacher Education Division (TED) of the Ghana Education Service (GES)

for teachers and headteachers to enable them improve the teaching of the three areas mentioned above. It is hoped that by the end of the year, 2001 the intervention 'scheme' would have been adopted by all primary schools in the country (GES, 1999).

As far as the teaching of mathematics is concerned, a number of guidelines have been introduced through the WSD programme which are in line with the constructivist philosophy. For example, teachers of mathematics are being asked to encourage pupils to talk about their work and also to pose and solve their own problems. Group work is also being encouraged and education officials whose roles were mainly inspectorial are now being asked to provide support for teachers to enable them teach better rather than simply pass evaluative judgements on teachers' work. It is early days yet and the full impact of the WSD process may not be known until in about three or more years time when all primary schools in the country may have been taken on board. Nevertheless, reports from monitoring teams (TED, 1999) suggest that, with regard to the teaching of mathematics, the envisaged change is becoming visible in the pilot schools.

Concerning the assessment of mathematical attainment, the constructivist concept is arguably far removed from the traditional forms of tests, not only because the pupil is given the opportunity to take part in the assessment process, but the pupil is assessed on what he or she has learnt (Garcia and Pearson, 1994). . Indeed, by allowing pupils an opportunity to assess themselves and by encouraging regular dialogue with teachers, the way is open for pupils to make comments about why they have not achieved a particular goal. Pupils may find themselves becoming increasingly involved in assessing the nature and quality of the mathematics being taught and how it is being taught.

A way forward is to seriously consider the alternative assessment procedures which encourage the use of different variety of instruments (Huerta-Macias, 1995). Yet lack of expertise among mathematics teachers particularly in the basic schools means there will be practical problems in the assessment of pupils' performance in constructivist settings. This can make the constructivist agenda difficult to pursue in mathematics Education in Ghana, at least, for now.

Nevertheless, as mentioned above, the WSD programme can be the starting point and provided all mathematics teachers can be exposed to the programme, the country may make headway as far as the much needed switch is concerned.

Until mathematics teachers at all levels of the educational system are given the required training, it is difficult to see how constructivism can flourish in mathematics Education in Ghana.

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The Relationship between Students' BECE and SSSCE Grades in Mathematics

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Abstract

The purpose of the study was to find out whether there was a relationship between students' performances in mathematics in the Basic Education Certificate Examinations (BECE) and Senior Secondary School Certificate Examinations (SSSCE) in the Cape Coast Municipality. A sample of 400 students from two randomly selected schools was used. These 400 students were made up of two groups of 100 each from one school who took their BECE in 1996 and 1997 and another two groups of 100 each who also took their BECE in 1997 and 1998. The BECE performances of the 1996 and 1997 were compared with their respective SSSCE performances in 1999 and 2000. Similarly, the BECE performances of the 1997 and 1998 groups were compared with their respective SSSCE performances in 2000 and 2001. The SPSS software was used to analyze the results. The results show that there were no significant correlations between the BECE Mathematics performances and that of the SSSCE. All the hypotheses were tested at five percent level of significance.

Introduction

Research has shown that there was a significant correlation between Ordinary Level (O/L) Mathematics performance and that of the Advanced Level (A/L) (Wuddah, 1981). Wuddah (1981) studied the relationship between students' grades at the O/L and the A/L not only in Mathematics but also in Physics, Chemistry, Biology, Geography, Economics, Government, History, Bible Knowledge, English Literature and French. Students' 1977 O/L grades in these subjects were compared with their corresponding 1979 A/L grades. Again the 1978 O/L grades in the same subjects were compared with the 1980 A/L grades for the same set of students. In all these, it was only in Government that had no significant correlation. Wuddah (1981), therefore, concluded that since the O/L performance was related to that of the A/L, the practice of selecting sixth formers on the basis of the O/L results should continue.

Soriyan (1973) did similar studies comparing School Certificate grades with that of Higher School Certificate grades in seven subjects, including mathematics. Soriyan (1973), found that some of the correlations were significant while others were not. Soriyan (1973), therefore concluded that since some candidates might pass the O/L with distinction and fail A/L and vice versa, school heads had to be liberal in their requirements for selection into the sixth form schools. Andrews (1982) study also shows that performance at the Common Entrance Examinations was not related to the School Certificate Examinations.

Eshun (1999) also compared mathematics performance of 1528 students from 12 schools in mock examinations with their West African Examinations Council's Ordinary Level examination in mathematics. Eshun (1999) concluded that there was significant correlation between the grades at these two levels, hence there was the need for mock examinations for final year students.

Procedure

Population and Sample

Simple random sampling techniques were used to select Wesley Girls' High School (WGHS) [coded School A] and Adisadel College [also coded School B] for the study. Examinations results of two batches from each school were used. These batches include: for WGHS, students who sat for the BECE in 1997 and 1998 and their corresponding results for the SSSCE in 2000 and 2001. For Adisadel College, students who sat for the BECE in 1996 and 1997 and their corresponding results for the SSSCE in 1999 and 2000 were involved in the study. An average of 340 students from WGHS and 622 students from Adisadel College wrote the SSSCE each year (during the period of study). However, these numbers keep on increasing each year. A sample of 100 students was however selected from each batch giving a total of 400 students involved in the study. Random numbers were used to select these students. Results of these students were obtained from the schools as well as the Municipal Education Office, Cape Coast.

Results and Discussion

The SSSCE grades of students were coded as follows A – 1; B – 2; C – 3; D – 4; E – 5 and F – 6. Table 1 gives the frequency distribution of grades at the BECE and SSSCE of selected students in school A.

Table 1 Frequency Distribution of Grades at BECE and SSSCE in School A

GRADE	BECE (1997)	SSSCE (2000)	BECE (1998)	SSSCE (2001)
A (1)	90	58	92	46
B (2)	10	28	8	24
C (3)	-	4	-	10
D (4)	-	2	-	6
E (5)	-	6	-	10
F (6)	-	2	-	4
TOTAL	100	100	100	100

Table 2 also gives the frequency distribution of grades at the BECE and SSSCE of the selected students in school B.

Table 2: Frequency Distribution of Grades at the BECE and SSSCE in School B

GRADE	BECE (1996)	SSSCE (1999)	BECE (1997)	SSSCE (2000)
A (1)	98	12	96	24
B (2)	2	18	4	26
C (3)	-	12	-	12
D (4)	-	14	-	14
E (5)	-	30	-	16
F (6)	-	14	-	8
TOTAL	100	100	100	100

A glance at Tables 1 and 2 indicate that while all the students passed with grades 1 or 2 at the BECE in both schools, the story was different at the SSSCE level. For example in school A while 90 percent of the selected students passed mathematics with Grade 1 at the BECE in 1997, 58 percent of the same students passed mathematics with Grade A at the SSSCE in 2000. In school B, while 98 percent of the selected students passed with Grade 1 in mathematics at the BECE in 1996, only 12 percent of the same students passed with Grade A in mathematics at the SSSCE in 1999.

Hypothesis

It was the expectation of the researcher that there was a correlation between the mathematics grades of the BECE and those of the SSSCE. Thus the null hypotheses were formulated as follows:

- There were no correlations between the mathematics grades at the BECE and those of the SSSCE.
- There were no significant differences between the mean grades of the BECE mathematics grades and those of the SSSCE mathematics grades.

The null hypotheses were stated in this way because if there were correlation between the two sets of grades then there should not be significant difference between them. Table 3 shows the output from SPSS showing the basic statistics and the various correlation coefficients of the selected groups.

Table 3: Basic Statistics and the Correlation Coefficients

Paired Samples Statistics

SCHOOL A	Mean Grade	N	Std. Deviation	Std. Error Mean
WGHS-BECE (1997) WGHS-SSSCE (2000)	1.1000 1.7600	100 100	0.3015 1.2319	3.015E-02 0.1232

Paired Samples Correlations

SCHOOL A	N	Correlation	Sig.
WGHS-BECE (1997) & WGHS-SSSCE (2000)	100	0.228	0.022

Paired Samples Statistics

SCHOOL A	Mean	N	Std. Deviation	Std. Error Mean
WGHS-BECE (1998) WGHS-SSSCE (2001)	1.0800 2.2200	100 100	0.2727 1.5214	2.727E-02 0.1521

Paired Samples Correlations

SCHOOL A	N	Correlation	Sig.
WGHS-BECE (1998) & WGHS-SSSCE (2001)	100	-0.092	0.365

Paired Samples Statistics

SCHOOL B	Mean	N	Std. Deviation	Std. Error Mean
ADISCO-BECE (1996) ADISCO-SSSCE (1999)	1.0200 3.7400	100 100	0.1407 1.6552	1.407E-02 0.1655

Paired Samples Correlations

SCHOOL B	N	Correlation	Sig.
ADISCO-BECE (1996) & ADISCO-SSSCE (1999)	100	-0.151	0.134

Paired Samples Statistics

SCHOOL B	Mean	N	Std. Deviation	Std. Error Mean
ADISCO-BECE (1997) ADISCO-SSSCE (2000)	1.0400 2.9600	100 100	0.1969 1.6571	1.969E-02 0.1657

Paired Samples Correlations

SCHOOL B	N	Correlation	Sig.
ADISCO-BECE (1997) & ADISCO-SSSCE (2000)	100	-0.119	0.239

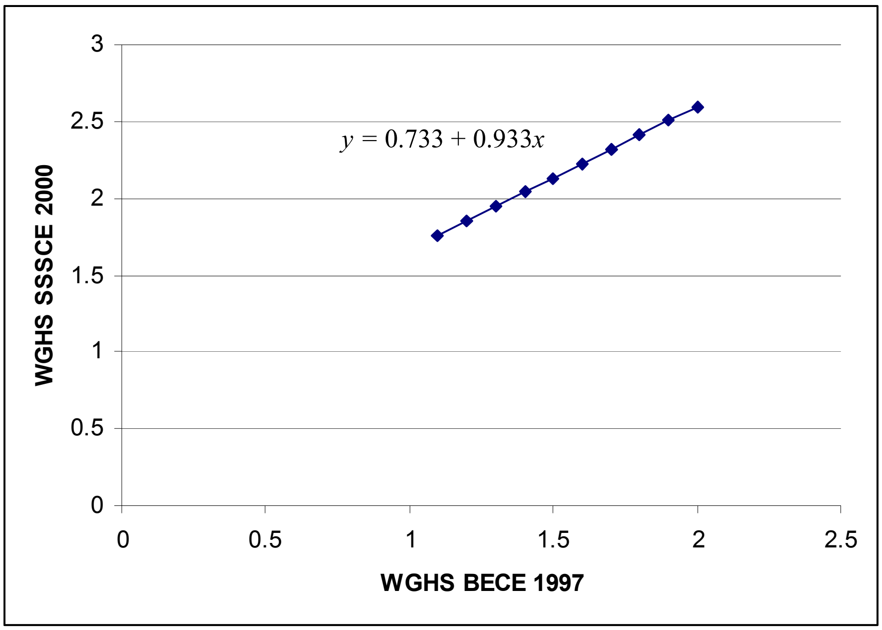
As shown in Table 3 above, the correlation between 1997 BECE grades and those in 2000 SSSCE grades in school A was 0.228 with *p-value* of 0.022 (< 0.05). This means that there was some correlation between the 1997 BECE grades and the 2000 SSSCE grades in school A. A correlation coefficient of 0.228 indicates a weak correlation.

The correlation coefficient for the 1998 BECE grades and those of the 2001 SSSCE grades in school A was –0.092 with a *p-value* of 0.365. This indicates that there is no correlation between the two sets of grades since there is no significant correlation. Indeed, a correlation coefficient of –0.092 is indication of very weak negative linear relation.

In school B, the correlation coefficient between the mathematics grades in the 1996 BECE and that of 1999 SSSCE was –0.151 with a *p-value* of 0.134. That for the 1997 BECE mathematics grades and those of the 2000 SSSCE grades was –0.026 with a *p-value* of 0.797. In both cases there were no significant correlations. Again there are weak negative linear relations between the two pairs of sets of grades

The regression plot with the associated prediction line for the 1997 BECE mathematics grades and those of the 2000 SSSCE mathematics grades is shown in graph below.

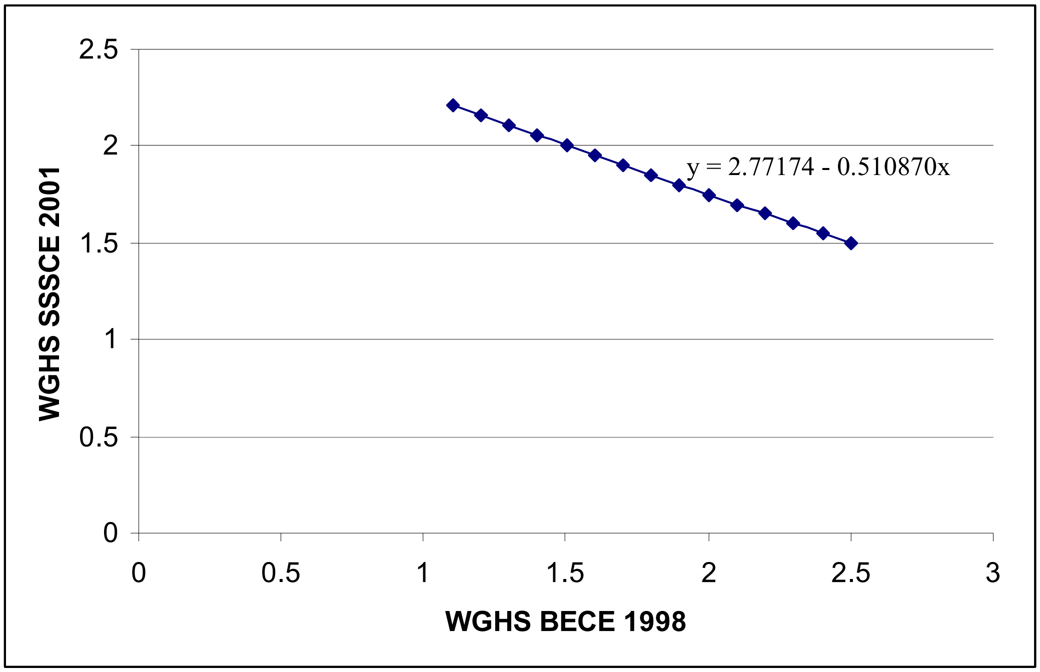
Fig. 1 Regression plot of WGHS 1997 BECE against 2000 SSSCE mathematics grades



A closer look at the prediction equation shows that it is a poor predictor. For example using the prediction line equation $y = 0.733 + 0.933x$ (where y represents a mathematics grade for SSSCE 2000 and x, the 1997 BECE mathematics grade for school A) then a candidate who had grade 1 in the BECE should be expected to obtain a grade of 2 or B at the 2000 SSSCE. However, in 1997, there were 90 out of the 100 students who obtained grade 1 in the BECE mathematics examination. Out of the same 100 students, 58 obtained grade A (1), 28, grade B (2), 4, grade C (3), 2, grade D (4), 6 grade E (5) and 2 grade F at SSSCE.

The relationship between 1998 BECE mathematics grades and the SSSCE mathematics grades for school A is also displayed on the regression plot in Fig. 1.

Fig. 2 Regression plot of WGHS 1998 BECE against 2001 SSSCE mathematics grades

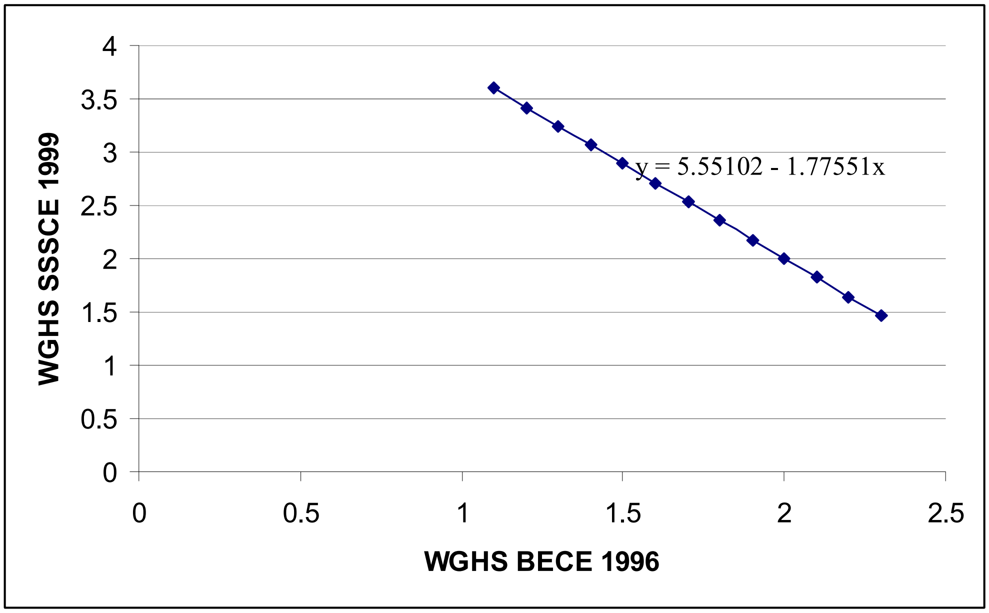


The regression line in Fig. 2 shows a weak negative linear relation and the prediction line equation is a poor predictor. An interesting feature of this relation is the negative correlation, meaning a high grade in BECE should result in a low grade in SSSCE. In school B, the regression plot for mathematics grades for 1996 BECE and those of 1999 SSSCE mathematics grades is shown in Fig. 3.

Just like the previous graph, there is an inverse relationship between the 1996 BECE mathematics grades and the 1999 SSSCE mathematics grades. Again the prediction equation is not a good predictor.

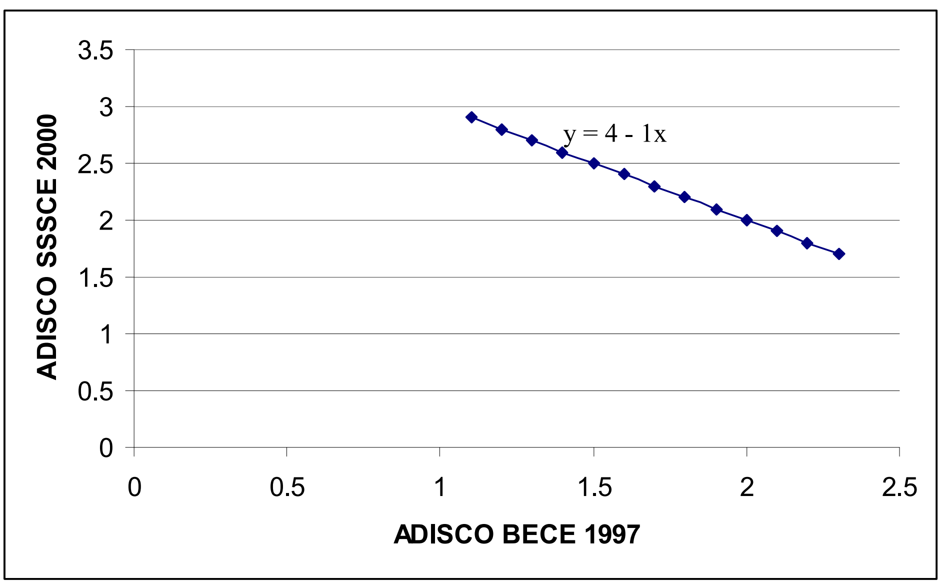
With reference to the equation, a BECE grade of 1 should result in a SSSCE grade of 4, while a BECE grade of 2 should result in a SSSCE grade of 2. However, from Table 2, 98 out of the 100 students obtained grade 1 at the BECE in 1996 in school B, while the remaining 2 obtained grade 2. Interestingly, the 1999 SSSCE grades obtained by the same students were as follows: grade 1 – 12; grade 2 – 18; grade 3 – 12; grade 4 – 14; grade 5 – 30 and grade 6 – 14.

Fig. 3 Regression plot of WGHS 1996 BECE against 1999 SSSCE mathematics grades



The regression plot of the1997 BECE mathematics grades and the 2000 SSSCE mathematics grades for school B depicture similar features as can be seen in Fig. 4.

Fig. 4 Regression plot of ADISCO BECE 1997 against 2000 SSSCE mathematics grades



The graph shows a weak negative relationship between the two grades. It is interesting to note that apart from the relationship between the 1997 BECE mathematics grades and the 2000 SSSCE mathematics grades for school A that showed positive weak correlation, all the others showed negative weak correlation.

On the other hand, if the grades are considered as scores and the mean grades are computed, the hypotheses that there are no significant difference between the mean grades were tested all at a significance level of five percent. In school A, the first hypothesis was that, there was no significant difference between the mean grade of the 1997 BECE mathematics grades and that of the 2000 SSSCE mathematics grades. The out from SPSS for this test is shown in Table 4.

Table 4 Paired Samples Test

			Paired Differences				
School A	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper	t	df	Sig. (2-tailed)
BECE 1997 & SSSCE 2000	-0.6600	1.1995	0.1199	-0.8980 -0.4220	-5.502	99	0.000

From Table 4, the *t-value* for the test was –5.502 with a *p-value* of 0.000. This is highly significant, indicating that there is a difference between the mean grade of the 1997 BECE mathematics grades and that of the 2000 SSSCE mathematics grades. This indicates that there is no correlation between the two grades. If there were to be correlation between the grades, then we should not expect the two sets of grades to differ significantly. Tables 5, 6 an7 show the remaining tests.

Table 5 Paired Samples Test

			Paired Differences				
School A	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper	t	df	Sig. (2-tailed)
BECE 1998) & SSSCE (2001)	-1.1400	1.5700	0.1570	-1.4515 -0.8285	-7.261	99	0.000

Table Paired Samples Test

			Paired Differences					
School B	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
BECE 1996) & SSSCE (1999)	-2.7200	1.6822	0.1682	-3.0538	-2.3862	-16.169	99	0.000

Table 7 Paired Samples Test

			Paired Differences					
School B	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
BECE 1997) & SSSCE (2000)	-1.9200	1.6918	0.1692	-2.2557	-1.5843	-11.349	99	0.000

As shown in the above tables the results indicated significant differences between the BECE grades and the SSSCE grades in mathematics. Indeed, all the four null hypotheses were rejected at five percent level of significance since in all the tests the *p-value* in each case was less than 0.05. [In all the tests, *p-value* was 0.000 as seen in the Tables above.]

All these are reflected in the regressional plots. The graphs show very weak correlations implying that the BECE results may not be used to predict the SSSCE results in mathematics. This seems to be contrary to Wuddah's (1981) study of O/L and A/L. However, these results confirm Oppong's (1999) study. It appears, therefore, that the assessment at these two levels seems to be different. Perhaps the drastic decline in the performance at the SSSCE might be partially attributed to inflation of continuous assessment marks at the JSS level for candidates to ensure their good performance. This view is supported by Omari (1994) who says that teachers dream up the continuous assessment marks at the JSS. This to the researcher is quite strong an expression. What the researcher would suggest to headmasters and headmistresses is that they should be cautious in their admission of JSS students in their senior secondary schools, for the BECE grades seem not to be reliable to predict the outcomes of SSSCE grades.

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Opportunity to Learn English and Mathematics in Ghanaian Primary Schools: Implications for Teacher Education Programmes

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The Ghana Basic Education Comprehensive Assessment System (BECAS) is a new assessment system which replaced national tests that were instituted since the 1992 to monitor primary school pupils' achievement and progress in English and Mathematics. To ensure the new system assesses closely what teachers actually teach, the BECAS Team carried out a survey of the contexts of learning in primary schools to inform the development of a new comprehensive assessment system. The study examined whether or not the opportunities provided in primary schools for learning are good enough to promote learning for all of pupils and assure high levels of outcomes for all pupils. The study which involved 1,063 teachers sampled from the ten regions of the country was carried out in schools in July 2004. A questionnaire was used to gather data on teachers' schools, classes taught, location of schools, class size, gender, professional qualifications, instructional resources for teaching English and mathematics, instructional time for teaching English and mathematics, and coverage of content of English and mathematics in teachers' instruction over the year. A major finding of the study was that OTL standards for most schools were very low and it was observed that the majority of teachers completed nearly 60% of the content of the mathematics and English syllabuses. The analysis also indicated that there were grave inequalities between schools as well as districts in the following

- availability and adequacy of textbooks,
- availability and adequacy of instructional materials,
- teachers' instructional practices and management of instructional time, and
- teachers' preparedness to implement the content standards.

These inefficiencies could be attributed to the fact that the curriculum content standards are clearly defined by the syllabuses of the various subjects taught at the basic level, no OTL standards have been set to guide their implementation. It is recommended that CRDD should be made to set OTL standards that will assure a high level of achievement for all pupils. That is, state the indicators that will assure a fair and appropriate provision of inputs and processes in basic schools. Also teacher education programmes should ensure that teachers are not only exposed sufficiently to OTL standards but also the strategies that they can be adopted to ensure such standards are maintained and improved.

Introduction

Five years after the Educational Reform Programme was initiated in 1987, a national test, designated Criterion Referenced Test (CRT) was instituted to assess Primary 6 pupils' achievement in English and Mathematics. Despite the fact that the CRT was a quality assurance measure, it was instituted principally to ensure whether or not the processes and inputs introduced during the educational reforms were helping to improve the quality of education (CRDD, 2001). The USAID assisted the Ministry of Education in the development and administration of the CRT from 1992 to 1999. Though the CRT indicated that less than 10 percent of the pupils are reaching mastery and the performance in both English and Mathematics

has been rising slowly but steadily beginning from the base year of 1992, it could not provide enough information to assess the effectiveness of the processes and inputs introduced during the educational reforms.

It has been observed that pupils perform best on tests that assess subject matter content which pupils have had the opportunity to learn (Gamoran, Porter, Smithson, and White, 1997; Robitaille, et al, 1994). Though supported time and again by research, this observation is little more than common sense. In connection with assessment, Winfield (1987:438) notes that opportunity to learn relates to "the provision of adequate and timely instruction of specific content and skills prior to taking a test". She adds that opportunity to learn may be measured by "time spent in reviewing, practicing, or applying a particular concept or by the amount and depth of content covered with particular groups of students" (p. 439).

One the major limitation of the CRT was that the test coverage exceeded the realities of the classroom. Items for the CRT covered the entire curriculum (syllabus) for Primary 6 and outcomes pupils attained were compared with the entire intended curriculum, even though a substantial proportion of the content prescribed in the syllabus could not be implemented under the conditions that prevailed in schools. Though curriculum content standards in the various Ghanaian primary school subjects are clearly defined by syllabuses designed by CRDD, little is said about the processes and inputs required for their attainment. That is, the curriculum content standards we currently have in this country are silent over the *opportunities to learn* that must be provided to promote high level of achievement for all pupils.

Opportunity to learn refers to equitable conditions or circumstances within the school or classroom that promotes learning for all students (Porter, 1993). It includes provision of curricula, teaching/learning material, facilities, teachers, and instructional experiences that enable students to achieve high standards. The term also refers to absence of barriers that prevent learning. The present opportunity to learn study was included in the planning of the Ghana Basic Education Comprehensive Assessment System (BECAS) to provide essential information that will ensure the quality of the assessments and the ethics of testing what is actually taught. Finally information from the study would guide the development of the new National Education Assessment (NEA), which is being developed under the BECAS project, to make it assess performances on what is actually taught, as well as document what aspects of the curriculum go unlearned and/or untaught.

Studies in national curriculum in Ghana

OTL standards can be defined as the criteria for, and the basis of assessing the sufficiency or quality of the resources, practices, and conditions necessary at each level of the education system to provide all students with the opportunity to learn the material in national curriculum (Ysseldyke, Thurlow, and Shin, 1995). No study in Ghana has looked fully at the curriculum delivery standards. Two studies have examined aspects of these standards.

The first was a study commissioned by the Ghana Ministry of Education in 1993 to examine and analyze the primary school official curriculum materials – syllabuses, pupils' textbooks and teacher's guides. The study reported that mathematics teaching in basic schools focuses on

computation skills, learning of formulas, rote practice and teaching as telling. The study also reported that the vast majority of Ghanaian children are growing up functionally illiterate in both their native language and in English. The principal investigator in this study, Kraft (1994), attributed these unfortunate developments to the poor nature of curriculum, including syllabi, textbooks and teachers' handbooks, used in the nation's schools. He argued that

> the current syllabi, textbooks and teachers' handbooks do not meet the highest international standards, nor the current best thinking on sequence, learning and pedagogy and will not prepare Ghanaian students for the needs of the next century (Kraft:2).

The second study was TIMSS-2003, which was the third in a series of studies undertaken once every four years by the International Association for the Evaluation of Educational Achievement (IEA). The performance of the junior secondary school form 2 (JSS2) students in the TIMSS was unsurprisingly very poor because of the nature of mathematics students are made to experience at school in this country (Anamuah-Mensah, *et al*., 2004). Analyses of the students' performance on the TIMSS mathematics test items show that the few (about 15%) items for which most students were able to make correct responses were those that were testing knowledge of facts and procedures. They performed poorly on items that tested their ability to use concepts, solve non-routine problems and reason mathematically.

Analysis of the TIMSS data on the context for learning mathematics in Ghanaian schools indicate students have little opportunity to engage in activities that will enable them to use concepts, solve non-routine problems and reason mathematically (Mullis, *et. al*., 2004). Anamuah-Mensah, *et al*. (2004) observed that only 42 percent of Ghanaian JSS mathematics teachers used the mathematics textbooks as the main basis for mathematics lessons while 54 percent used it as a supplementary resource. Thus, the textbooks were used mainly by Ghanaian teachers as a supplement to other materials that teachers may have in their possession. This was not the case in most of the high performing countries such as Singapore, Korea and Japan, where the textbooks were the primary materials used in teaching the subject. In Ghana, the textbooks were used mainly as a supplementary resource because they are obsolete and do not align with the current syllabuses in school.

Purpose of the study

In order to come out with a comprehensive assessment system that can ensure all primary school pupils do reasonably well or do not feel failures, it is necessary to consider the OTL provided in the primary schools. It is necessary to know whether or not the opportunities provided in primary schools for learning are good enough to promote learning for all of pupils and assure high levels of outcomes for all pupils.

The purpose of the study was to find out

- teachers' preparedness to implement the content of the national curriculum in English and mathematics
- the adequacy and availability of resources provided for the delivery of the national curriculum content in English and mathematics;
- how well the instructional times for teaching English and mathematics were managed;

- extent of teachers' coverage of the national curriculum content in English and mathematics
- extent of teachers' emphasis in the national curriculum content in English and mathematics
- teachers' content emphasis for individual students or groups of students (i.e. whether or not the content is differentiated to ensure each student achieves his/her highest potential);

The study did not cover all aspects of OTL for Ghanaian schools.

Methodology

The study involved 1,063 teachers teaching in primary schools in the country. There were both trained and untrained teachers of which 44.1% were male and 55.9 were female. A questionnaire was used to gather data on teachers' schools, classes taught, location of schools, class size, gender, professional qualifications, instructional resources for teaching English and mathematics, instructional time for teaching English and mathematics, and coverage of content of English and mathematics in teachers instruction over the year.

Findings

The main findings of the study were

i. Majority (84) percent of the primary school teachers have low teaching qualifications and a substantial proportion (12.3%) is not at all trained. It can be argued in this regard that the preparedness of the majority of teachers to implement the content of the curriculum in English and mathematics is low.

ii. Difficulties in teaching certain topics in the two subjects were expressed by 21 and 34 percent of the English and mathematics teachers respectively.

iii. The schools do not have sufficient resources to deliver high level of curriculum content and also to achieve higher levels of outcomes for all students. Only 21 percent of the teachers indicated that pupils' English textbooks were available and adequate while 43 percent indicated that pupils' mathematics textbooks were available and adequate. The environment for learning mathematics and English for many Ghanaian pupils is not conducive for teachers to deliver their best and help pupils to achieve their highest potentials.

iv. Lessons in many schools do not start early. The instructional time was often interrupted with co-curricular (or planned non-instructional) activities like, school worship, cleaning compound and classrooms, gardening, practicing sports for athletics meetings, practicing matching and cultural activities, just to mention a few.

v. More than half of the teachers (53%) indicated they followed the timetable, but as many as 47 percent did not rigidly follow it.

vi. About 30 percent of the teachers indicated that they were able to cover only half of the English syllabus. Only about 20 percent completed the syllabus but the majority was able to cover up to 80% of the content of the English syllabus.

vii. About 31 percent of the teachers indicated that they were able to cover only half of the mathematics syllabus content and 21 percent indicated that they were able to cover all the content. The majority was able to cover up to nearly 80% of the content of the mathematics syllabus.

viii. Certain topics/units were not taught by many of the teachers in the two subjects. Some of the unpopular topics in mathematics were shape and space, length, capacity and mass, decimals and percentage, investigations with numbers, time and money, collecting and handling data, chance, and area and volume. While some of the unpopular topics in English were library, story telling, drama, song, mechanical writing, poem and verse, and directions/instructions

ix. In teaching English, the teachers gave equal attention to comprehension/reading, writing/composition and language item (grammar and structure). But nearly half of them did not give adequate attention to units in oral language (listening and speaking). In teaching of mathematics, almost all teachers taught topics in number and numeral as well as shape and space. A substantial proportion of teachers gave little attention to the other content domains – operations/algebra, measurement and handling data.

x. Many of the teachers indicated they often or sometimes grouped their pupils by ability during mathematics and English lessons. However it was observed that classes were too large for organizing any effective group work. In about 25 percent of the classes the number of pupils in a class ranged from 31 to 40, and there were over 40 pupils in more than 40 percent of the classes.

Conclusion

It was found that the preparedness of the majority of teachers to implement the content of the curriculum in English and mathematics was low; and a substantial proportion experienced difficulties in teaching certain topics in the two subjects. The schools were also found not to have sufficient resources to deliver high level of curriculum content and also to achieve higher levels of outcomes for all students. Textbooks, classroom furniture and teaching/learning materials were inadequate in supply. Notwithstanding, classes were too large for organizing any effective group work. There were over 40 pupils in more than 40 percent of the classes. Besides, lessons in many schools do not start early and the instructional time in the year was often interrupted with co-curricular (or planned non-instructional) activities.

As a result, that a substantial proportion of the primary school mathematics and English curricula go untaught. Some of the unpopular topics in mathematics were shape and space, length, capacity and mass, decimals and percentage, investigations with numbers, time and money, collecting and handling data, chance, and area and volume. While some of the unpopular topics in English were library, story telling, drama, song, mechanical writing, poem and verse, and directions/instructions. Another consequence of the insufficient textbooks and resources to deliver the curriculum is teachers giving little attention to units in oral language (i.e. listening and speaking) and little attention to operations/algebra, measurement and handling data in mathematics.

Though curriculum content standards are clearly defined by the syllabuses of the various subjects taught at the basic level, the study has shown that no OTL standards have been set guide the implementation of these content standards. Hence there are grave inequalities between schools in

- availability and adequacy of instructional materials,
- availability and adequacy of textbooks,
- teachers' instructional practices and management of instructional time, and
- teachers' preparedness to implement the content standards.

Recommendations

The tests items for NEAs and SEAs developed for the BECAS should cover largely the critical objectives in the primary mathematics and English syllabuses which are usually taught by all teachers. This will also ensure there is match in content emphasis as well as coverage in the official curricula and what teachers actually teach.

The CRDD should be made to set opportunities to learn (OTL) standards that must be provided to promote high level of achievement for all pupils. It should indicate who should provide the resources that will be required to meet the OTL standards for teaching in basic schools. In doing so, they should make a list of resources that schools can be encouraged to acquire themselves in the implementation of the content standards and those that have to be supplied by the government.

The CRDD should also advise the MOES on issues relating policy on class sizes, INSET and continuing professional education of teachers, use of instructional time,

Textbooks that match the revised syllabuses for mathematics and science should be purchased for teachers.

A quality assurance mechanism should be put in place to ensure schools meet these standards in the implementation of the content standards.

Implication for Teacher Education Programmes

Teacher education programmes should ensure that teachers are not only exposed sufficiently to OTL standards but also the strategies that can be adopted to ensure such standards are maintained and improved.

Prospective and in-service teachers should be sufficiently exposed to standards on

- educational input/resources,
- teachers' instructional practices,
- management of instructional time, and
- continuing in-service education and training (INSET) that will improve teachers' efficacy.

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Gender Differences in Junior Secondary School Pupils' Intention to Participate in Elective Mathematics at the Senior Secondary Level

Joseph Issah Nyala

Abstract

The study investigated the intentions to participate in elective mathematics of JSS pupils. The purposive sampling method was used to select nine Junior Secondary Schools in the Cape coast Municipality involving 581 pupils. Questionnaires on intention to participate in elective mathematics were used to gather data. The analysis of data involved calculating means and finding significant differences in means of specific respondents using Kruskal-Wallis test. The results of the analysis indicated a positive intent to participate in elective mathematics at the SSS level by both sexes.

Introduction

Although findings may vary in the literature on gender differences in mathematics participation, many studies (Armstrong, 1979; Robitaille and Sherill, 1977; Fennema, 1978; Wyoming, 1978) as cited in Lamb (1997), reveal a low participation in non-compulsory mathematics courses by females than males. In Ghana, female participation is not only lower than that of males but females are in reality under-represented. Eshun (1987) reported that out of 200 mathematics graduates from the University of Cape Coast, only four were females. Dekkers et al (1991) reported higher enrolment rates in university approved mathematics courses in the final year of secondary school by boys across the Australian States and territories, thus revealing the higher involvement in mathematics by boys than girls.

Lamb (1997) cited Teese (1994) as having reported that in 1990 there was a 14% gap in favor of males in the Australian state of Victoria. In Ghana, Eshun (2000) found a similar wide gap when he reported that while the percentage of Senior Secondary School males who participated in elective mathematics increased significantly from only 14.0% in 1995 to 35.85 in 1999, the percentage of females increased from 4.1% in 1995 to only 13.1% in 1999.

The under-representation of females in mathematics has important implications. There will be a higher male population in courses like the physical sciences and engineering in the universities than females. However, a strong foundation in mathematics is a pre-requisite for many careers and jobs. This is to say that there would be more males in such careers and jobs than females. This is confirmed by Lamb (1997) as he reports that in the Australian state of Victoria large differences existed in such higher-level mathematics careers and jobs.

Education is the key to a nations' success, and mathematics is observed to be of fundamental significance in this process. A study to investigate the intended participation in elective

mathematics by Ghanaian school children at the Junior Secondary level is very relevant. Even though students at this level can only indicate intentions to study elective mathematics, their expressed intentions can be used to predict their participation at the Senior Secondary School and higher levels.

Reporting on the transition of children from primary to secondary school in Great Britain, Walden & Walkerdine (1985) and Walkerdine (1989) stated that while girls were still performing as well as boys, by the fourth year of Secondary School, they were often perceived by the teachers as being less confident and were not helped in the subject, neither were they encouraged to take the more prestigious ‘O’ and ‘A’ level examinations in the Senior School.

Purpose of the Study

The purpose of this study is to investigate the intention to participate in the study of elective mathematics at higher levels of Ghanaian Junior Secondary School (JSS) students and determine any gender differences.

Methodology

The targeted population for the study was Junior Secondary School (JSS) pupils in the Central Region. The sample was taken from the final year group of the Junior Secondary Schools in the Cape Coast Municipality.

The sample comprised five hundred and eighty-one (581) pupils from nine (9) schools in the Cape Coast Municipality of the central Region. Two were private JSS, and the rest were either of single-sex male, single-sex female or mixed public schools. The breakdown is shown in table 1.

Table 1 Distribution of Pupils by Type of School

Type	Number
Single-sex male	61
Single-sex female	158
Mixed male	172
Mixed female	190
Total	581

The targeted schools were visited and the Headmasters (J)/Headmistresses (J) served with copies of a letter seeking permission to conduct the study. The heads were notified of the intended period when the study would be conducted and asked to specify a convenient day on which they could make their pupils available for the study involving a questionnaire.

The selection procedure described above was chosen so as to suit the descriptive survey type of study chosen. As pointed out by Gay (1987), this design involves collecting data in order to test hypotheses or to answer questions concerning the current status of the subject of the study.

Instrument

The instrument employed for the data collection was participatory questionnaire items. The Likert scale was used in preparing a questionnaire instrument. Each statement had five options of which one was selected according to the respondent's feelings. Weights of 1, 2, 3, 4 and 5 were attached to the options of "Strongly Discouraged (SD)", "Discouraged (D)", "Undecided (U)", "Encouraged (E)" and "Strongly Encouraged (SE)" respectively.

Mean scores were calculated on scores of responses made. Any mean above three was taken to indicate a positive intent to participate in mathematics, whilst a mean score below three suggested a negative intent to participate.

Subjects were made to respond to thirty-two (32) items comprising, ten items on the respondent's background, and twenty-two items on respondent's intention to participate in elective mathematics of the questionnaire's close-ended items. Subjects were to provide a tick or write down the most appropriate initials of the pre-printed responses of each item.

Participatory Factors

Twenty-two questions of the intended participatory factors were classified under eight broad dimensions. These were: parental influence, career influence, clinics/workshops, teacher influence, the curriculum, effective motivation, female role model, and peer influence. Each dimension consisted of a collection of the various items into a unit that pointed to specific aspects of the intended participatory factors. For instance, "how would you be encouraged to do mathematics if you are always under a terrible pressure in mathematics class?" suggests a feeling of mathematics anxiety while "how would you be encouraged to do mathematics if you are well informed about careers that require mathematics?" suggests the factor, career influence. Table 2 shows a classification of the intended participatory items into units.

Table 2 **Questionnaire Items Contributing to the Various Dimensions by Nature of Statement**

Intended Participatory Factor	Statement
Parental influence	11, 15
Career influence	12, 17, 18
Clinics/Workshops	19, 25, 27
Teacher influence	13, 20, 22, 23, 24, 32
Curriculum	14, 21, 56
Effective Motivation	28, 31
Female Role Model	26, 30
Peer influence	16, 29

Kruskal-Wallis analysis of variance was used to compute and test whether there were any significant differences between the mean responses of:

a) girls in single-sex schools and boys in mixed schools
b) girls in single-sex schools and girls in mixed schools
c) girls in single-sex schools and boys in single sex schools

d) boys in mixed schools and girls in mixed schools
e) boys in mixed schools and girls in mixed schools.

Results of the Study

About two-fifths, representing 40% of the respondents were males whilst three-fifths, representing 60% of respondents were females. Of the males, there were more males from the mixed schools than males from single-sex schools. This was intended to find out whether the presence of females would have any effect on the males' decision. Of the females, there were more females from mixed schools than females from single-sex schools.

The average age of respondents was found to be 15.0 years. Only one pupil was ten years old whilst 19 pupils were aged 18 years. The highest number of respondents was from the age of 15 years. This implies that much as there were a few respondents with ages falling outside the expected age range of 14 to 16 years, the majority fell within the age range. For those wishing to proceed to the senior secondary school, 95.4% responded in the affirmative. Only 3.4% would not want to proceed to the SSS. This implies that majority of the students in the study would want to study at the SSS. To the vital question, "will you like to do elective mathematics at the SSS?" 67.6% expressed the desire to study the subject. Of this percentage, 41.8% were females and 25.8% were males. Thus, more females planned for elective mathematics at this stage. Hence the possibility of females dominating in mathematics related courses at the higher levels if they are able to meet their intentions.

To determine the rate at which students of JSS express their intention to participation in elective mathematics, the number of students who expressed their intentions to study elective mathematics at the senior secondary school was tabulated in table 3.

Table 3 Number of Students Intending To Study Elective Mathematics at the SSS

Choice of Subject	Male	Female	Total
Elective Mathematics	153	240	393
No Elective Mathematics	80	108	188
Total	233	348	581

Table 3 shows that more females than males expressed their intentions to study elective mathematics. The results of table 3 were expressed in percentages along two broad categories of male and female, and recorded in Table 4. The values obtained represented the rates of intended participation of the two sexes.

Table 4 Rate of Intended Participation by Sex

Percentage of students intending to study Elective Mathematics by Sex		
	Own Group	Total
Male	65.7	26.3
Female	69.0	41.3

Table 4 shows that females indicated a higher rate of intent to study elective mathematics than males, as they recorded a rate of 41.3% as against 26.3% by males.

Intended Participatory Factors

Table 5 shows means of scores of the eight intended participatory dimensions by type of school and sex.

Table 5 Means of Intended Participatory Scores by Type of School and Sex

Factors	Single-sex (Male)	Single-sex (Female)	Mixed (Male)	Mixed (Female)	All
Parental Influence	3.93	4.14	4.12	4.98	4.07
Career Influence	3.92	3.92	4.19	4.08	4.03
Clinics/Workshops	3.76	3.76	3.73	3.77	3.76
Teacher Influence	4.19	4.11	4.09	4.08	4.12
Curriculum	3.89	3.97	3.79	3.83	3.87
Effective Motivation	3.56	4.01	3.55	3.91	3.76
Female Role Model	2.94	3.58	3.63	3.71	3.47
Peer Influence	4.08	3.93	3.62	3.84	3.87

From table 5, it is clear that the mean scores for all students in the sample were above three. However, at category level, males in single-sex schools registered the only value below three. Thus, almost all the students selected positive items of the intended participatory dimensions. The highest mean responses were for teacher influence, career influence and parental influence in that order.

In all the eight dimensions, males attached more value to the factors, teacher influence and career influence than females, but the latter were more positive about parental influence. Thus, even though females are encouraged by their teachers and the types of careers they can do when they choose to study elective mathematics, they seem to be much more encouraged by their parents to opt to study the subject.

Discussions

The findings on rates of intention to participate in elective mathematics of JSS pupils indicated a difference in the rates by sex. This result implies that boys and girls probably had different encouragement levels to study the subject. Philips (1982) reporting on the effects of career unit on middle school students' attitudes towards mathematics and intentions to continue the study of the subject, stated that the unit positively altered students' attitudes towards mathematics.

Males and females expressed the same intentions to study elective mathematics at the JSS level. An implication is that if proper encouragement is given, more girls will participate in elective mathematics when they move to the SSS than we have now.

Males in mixed schools showed more interest in careers involving elective mathematics than females in mixed schools. The finding is consistent with findings by Looft (1971), Schlossberg and Goodman (1972) as they found evidence that girls are less career-oriented than boys. This is confirmed by the high indication by males that they would want to do careers such as engineering, piloting and accounting among their choices of future careers.

Females in single-sex schools indicated that they receive more support and encouragement from their parents in learning mathematics than males in mixed schools. Males in mixed schools also showed that they received more support and encouragement from their parents than females in mixed schools as was evident in their mean scores. On the whole, females indicated that they received more support and encouragement from their parents than males. As observed by Parsons et al (1983), children's attitudes were influenced more by their parents' attitudes than their own past performances within grades 5 to 11. A possible reason is that children tend to imitate more at this stage. Parsons et al (1983) also observed that most parents would want their wards to study mathematics and take mathematics related courses, as they see them as prestigious, and leading to more rewarding careers and jobs. The implication of this finding is that more career guidance and counseling talks and seminars should be organized for parents to equip them with relevant information to influence their wards.

From the findings, the following general conclusions were made on the students.
Females indicated that they would be encouraged to study mathematics if they received support from parents than males. As observed by Fox et al (1980), parental support in mathematics differs with the sex of the child, but is often in favor of the males. Findings in this study however indicated the contrary.

Both sexes depended greatly on their teachers in learning mathematics, but students in single-sex schools expressed the most dependence. This seems to suggest that teachers of JSS single-sex schools interact more with their students than teachers in mixed schools.

On the whole however, males showed that they received more support and encouragement from their teachers than females. This finding is supported by findings by Bean (1979) that teachers in mathematics classes tend to interact more with boys than with girls. Both sexes also indicated their support for encouragement from their peers.

In view of the above findings it is recommended that teachers modify their relationships with both sexes of students in their classrooms. Mathematics clubs should be reinstituted in our senior secondary schools. There is the need also to expand counseling services to parents as well.

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Constitution of the Mathematical Association of Ghana (MAG)

[Last Revised 2000]

1. **N A M E:**
The name of the Association shall be the Mathematical Association of Ghana (MAG).

2. **A I M S:**
The aims of the Association are as follows:
   a) To stimulate mathematical thinking in Ghana.
   b) To improve the teaching of mathematics in Ghana, and to acquaint members of new trends in mathematics and mathematics syllabuses.
   c) To initiate and develop links between teachers of mathematics, their pupils and other institutions requiring the application of mathematics.

3. **MEMBERSHIP**:
The Association shall consist of Ordinary members and Honorary members.

a) *Ordinary membership is open to:-*
   i) Practising teachers of mathematics in Educational Institutions.
   ii) Persons who are interested in or concerned with the teaching of the subject, or with its application in Government, Commerce or Industry.
   iii) Organisations concerned with the application of mathematics.

b) *Honorary Membership:*
   i) The Association at a general meeting may resolve by ordinary resolution that the Council may admit to honorary membership of the Association any person who has rendered a singular service to the Association or to any of the aims which the Association is formed to promote.
   ii) An honorary member shall have all the privileges of an ordinary member but shall not be liable to pay any subscription to the Association.

4. **RESIGNATION OR EXCLUSION OF MEMBERS**:

a) Any ordinary or honorary member may resign his membership by notice in writing to the Council;

b) The Council may at its discretion exclude from membership of the Association any ordinary member;

i) If the subscription payable to the Association by such ordinary member shall be unpaid six months after same shall have become due and payable; or

ii) If in the opinion of the Council the continued membership of such person would be detrimental to the interest of the Association or to the furtherance of its aims or both.

5. GENERAL MEETING:

A general meeting shall be held once in every two years in the course of national workshop/Conference.

6. **OFFICERS AND COUNCIL**:

a) The officers of the Association shall be the Chairman, the Vice-Chairman, the Secretary, the Assistant Secretary and the Treasurer.

b) The Council shall consist of the officers; one representative from each region, the president, an appointed editor and any co-opted members.

c) The Council shall manage the affairs of the Association for the realisation of its aims, and shall decide on matters not provided for in the constitution. The Council has power to co-opt any members of the Association to fill any vacancy in its membership or for the effective execution of its functions.

In exercising such power the Council might consider co-opting a member from the various levels of the educational system and from fields of application of mathematics.

d) All members of Council shall be members of the Association in good standing except the President who may be an honorary member.

e) Where there is no female member, the Council shall endeavour to co-opt one.

ELECTIONS:

a) The officers of the Association shall be elected at the General Meeting by a secret ballot.

b) For the purpose of election the Council shall appoint a Returning Officer and two Supporters who should not be seeking elections to the Council. Such a team may design their own procedure for the elections.

c) The President shall be appointed by the Council at its last meeting before the General Meeting.

d) Council Members take office upon election for two (2) years. A member may be eligible for another term of office but no member shall serve at the same post for more than two consecutive terms.

7. COUNCIL MEETINGS:

a) The Council shall meet at least twice annually and five (5) members. Two of whom shall be Regional representatives, shall constitute a quorum.

b) At all meetings of the Council, the Chairman shall preside and in his absence, the Vice-Chairman. If neither of them is present, the members present shall choose one of their members to preside.

8. DUTIES OF THE OFFICERS:

a) Chairman

He shall

i) preside over all meetings of the Council, officers and the General Meeting;

ii) Act as the Chief Executive of the Association;

iii) be a signatory to the Accounts of the Association,

iv) be the convenor of all meetings of the Council Officers and the General Meeting.

b) Vice-Chairman:

He shall

i. act in the absence of the Chairman;

ii. be the Chairman of the Workshops/Conference Committee;

iii. represent MAG on the Council of G.A.S.T.;

iv. perform such other duties as may be assigned by the Chairman or the Council;

c) Secretary:

He shall

i. Take down minutes at all Council, Officers and the General Meetings;

ii. Present an annual report on the activities of the Association

iii. Attend to all correspondence on behalf of the Association;

iv. Be a signatory to the Accounts of the Association;

v. Perform other duties as may be assigned to him by the Chairman or the Council.

d) Assistant Secretary

He shall

i) act in the absence of the Secretary;

ii) be the secretary to the Workshops/conference committee,

iii) keep an up-to-date register of members of the Association.

iv) Perform any other duties that may be assigned by the Chairman or the Council.

e) *Treasurer*

He shall

i) be the Trustee of the accounts of the Association,

ii) ensure the regularity of all accounting operations of the Association;

iii) present an annual audited financial statement to the Council and members of the Association;

iv) be a signatory to the Accounts of the Association;

v) represent the Association on the consultative Council of Teachers Association (C.C.T.A.);

vi) perform such duties as may be assigned by the Chairman or the Council.

f) *President*

He shall

i. oversee the general welfare of the Association.

ii. Present a presidential address at the General Meeting

9. **OFFICERS' MEETING**

(a) The officers shall meet from time to time to implement decisions of the Council.

(b) The Officers shall meet and take decision on behalf of the Council in emergency situations. Such a decision/decisions should be communicated to all members of the Council as soon as they are taken, for confirmation at the next Council Meeting.

10. SUBSCRIPTION

(a) Ordinary members shall pay such annual subscriptions as the members in general meeting shall determine by ordinary resolution from time to time.

(b) The subscription shall be due and payable on admission to membership and thereafter on the first day of September in each year or such other date as the resolution shall provide.

(c) A different subscription may be prescribed in the case of corporate bodies admitted to membership, or in the case of any person admitted to membership, or representing any institution, or as a full member of any recognised subject Association in Ghana.

(d) Ordinary members may opt for life membership my making a single prescribed payment.

11. FINANCE:

a) The financial resources of the Association shall be as follows:-

i) Subscription from members

ii) Subsidies from the Ghana Education Service (G.E.S.)

iii) Donations and legacies accepted by the Association

iv) Interest and revenue from its assets.

v) Royalties/Profits from Publications.

b) A current banking account shall be held in the name of the Association and the Treasurer is empowered to draw monies not exceeding Fifty Thousand Cedis (₵50, 000) from it and kept as imprest. The Treasurer may be the sole signatory for this amount.

c) Sums of money exceeding Fifty Thousand Cedis (₵50,000) may be drawn form this account only with the consent of Council. For such sums of money any *two* of the following: *Chairman, Secretary* and *Treasurer* shall be the signatories.

c) The Association's financial year shall be from August 1st to July 31st of each year. Its accounts shall be audited by a body appointed by the Council and copies of the balance Sheet circulated to members before the General Meeting.

13. NATIONAL WORKSHOP

National Workshop for members of the Association shall be held at least once in every two (2) years, for professional development in line with the aims of the Association.

14. DELEGATES CONFERENCE:

a) A delegates conference shall be held in between the General Meetings and shall be attended by the Council and three (3) representatives from each region; one of whom shall be a female member.

b) The delegates conference shall
   i. review the achievements of the Association;
   ii. make appointments to fill vacancies in the Council;
   iii. review the activities in the regions; undertake any other business on behalf of the Association that may be referred to it by the Council.

15. REGIONAL BRANCHES:

(a) Regional branches of the Association shall be formed in all the regions.

(b) There shall be a Regional Executive made up of the Chairman, Secretary/Treasurer and three (3) other members.

(c) Members of the Regional executive shall be elected at a regional meeting held in the regions before the General Meeting.

(d) The Regional Chairman or his representative shall represent the regional branch on the Council.

(e) Regional branches shall promote the aims of the Association in the regions.

(f) Regional branches shall be eligible for grants from the funds of the Association for the purpose of carrying out the aims of the Association on submission of financial statements supported with receipts and reports.

(g) Grants for each Region shall take into accounts its paid-up membership.

16. COMMITTEES

(a) The Council shall have the following committees:

i. Finance

ii. Workshop

iii. Projects

Additional committees may be formed when it becomes necessary.

The Council may appoint from its membership or from the members of the Association or from a combination of both members to serve on these committees.

(b) The terms of reference and duration of office of all committees shall be prescribed by the Council and all such committees shall be deemed to be committees of the Council.

17. REGISTER OF MEMBERS

A register of members shall be kept and individual membership cards provided. The following particulars shall be entered in the register:

(a) The names and addressed of members

(b) The date on which each person was entered in the register as a member.

(c) Subscriptions paid by each member annually.

18. THE SEAL

(a) The council shall be empowered to adopt a common seal for use by the Association and shall provide for the Association and shall provide for the safe custody thereof.

(b) The seal shall only be used by authority of the council or a committee of the council authorised by the council on their behalf and ever instrument to which the seal shall be affixed shall be signed by a member of the council and shall be countersigned by the chairman or secretary.

19. AMENDMENTS TO THE CONSTITUTION:

(a) Amendments to the Constitution can only be made at the General Meeting.

(b) Amendments must be proposed by one and seconded by another ordinary member of the Association, amendments must be received by the Secretary in writing at least two (2) months before the General Meeting at which it is to tabled.

(c) Notice of proposed amendments shall be made available by the Secretary to all members of the Association at least two (2) days before the General Meeting.

(d) Voting on amendments is by members present. An amendment is carried if at least two thirds of the total votes cast are in favour of it.

(e)

- i. The Council can undertake a general review of the constitution from time to time.
- ii. Such a revised constitution shall be made available to all regional executives for the consideration and discussion of members in their various regions.

iii. Such a constitution shall be valid if it is voted open by members at a General Meeting and carried by at least two-thirds of the total votes cast.

20. **ADOPTION OF REVISED CONSTITUTION**:

This revised constitution as promulgated at the 27th Biennial Annual Conference/Workshop on the 31st day of August 2000 is deemed to have come into effect on the 31st day of August 2000.